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SIXTH ANNUAL REPORT

OF THE

STATE BOARD

OF

HEALTH, LUNACY, AND CHARITY

OF MASSACHUSETTS.

SUPPLEMENT

CONTAINING THE

REPORT AND PAPERS ON PUBLIC HEALTH.

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1884-1885.

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JULY, 1885.

NOTICE.

In consequence of oft-repeated requests for copies of a Public Health Supplement to the Third Annual Report of the State Board of Health, Lunacy, and Charity (1881), the announcement is hereby made, that NO SUPPLEMENT was issued for that year. Hence the following is the correct order of the series as issued: —

1. Supplement to the *First* Annual Report of the State Board of Health, Lunacy, and Charity, . . 1879

2. Supplement to the *Second* Annual Report, . . 1880

None issued for 1881.

4. Supplement to the *Fourth* Annual Report, . . 1882

5. Supplement to the *Fifth* Annual Report, . . . 1883

6. Supplement to the *Sixth* Annual Report (present issue), ... 1884

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GENERAL REPORT.

The following Supplementary Report of the Department of Health contains the investigations and papers presented to the Board, relative to public health for the year 1884, upon the following subjects : —

The Sanitary Condition of School-Houses of Massachusetts.
Reports of the Analysts of Food and Drugs.
Summary of the Weekly Mortality Returns of Massachusetts Cities and Towns.
The reports upon Illuminating Gases.
Epidemic Cholera.
Disinfection.
Health of Towns.

The Sanitary Condition of School Buildings.

Dr. Lincoln's report upon the sanitary condition of school buildings in Massachusetts, contains the results of an inquiry made in compliance with a vote of the Board passed in July, 1884.

The number of scholars in attendance at the public schools in Massachusetts in the past year was 342,012,* or about one-sixth of the population of the State. It is a matter of the highest importance that the hygienic conditions in which these scholars spend a large part of the most valuable period of their lives should receive careful attention on the part of school officers. That such is not always the case is evident from the results of Dr. Lincoln's observations.

The contrast between the condition of scholars in the country school-houses, each with a single room, with defect-

* Forty-eighth Report of State Board of Education.

ive ventilation, heating and lighting, with drainage and water supply of the most primitive sort, and that of the pupils in many of the schools of cities and large towns, provided with the best appliances for the same purposes, is greater every year. About one-third of the school children of the State are taught in the smaller school buildings in country towns. Hence a considerable number of such schools have been visited and reported upon.

The system of forced ventilation referred to on page 13 has been introduced in some of the school-houses of Boston, and appears to operate successfully. In one of the school-houses visited, in which it has been introduced, an additional fan, operated by the same engine, ventilates the water-closets and the basement, the air being conducted to the chimney by a separate flue, having no connection with the general system.

Such an apparatus can be used successfully for buildings having several schools under one roof, and without very great expense for running it, the office of janitor and engineer being combined in one person.

About one hundred and seventy-five school buildings were visited in twenty-five cities and towns, and a fair average of the schools of the State is undoubtedly represented in the report. Some of the school-houses were new and in use for the first time. Some were regarded as models by the designers, while others were old and in a more or less discreditable condition.

Dr. Lincoln's remarks in another report upon the same subject are well worth repeating in this connection: "A child who enters a public school has become a fractional part of a machine. He has been well understood by persons who have watched him from his birth and who are deeply interested in him. He is now transferred to the care of strangers, who meet with him only five hours in the day, and whose interest in him is restricted by the fact that he forms but a fraction — say from one and one-tenth to two and one-half per cent. of the total group of children that is intrusted to the care of a teacher. He is held by the teacher a few months, and then passed on to another, again as a fraction, not as an integer. Does he not lose much as well as gain,

by this system? As regards his health, he loses that defence which the sympathy of the community always extends to an individual who is suffering conspicuously. Taken generally, all children in school are suffering some discomfort. Average the discomfort among ten thousand, and it may not be very great for each one. But a class of fifty children is not made up of fifty *averages*." *

An examination of Dr. Lincoln's report, presented in the following pages, is sufficient to show that the picture which he has drawn is not exaggerated. While the mental training of the scholar is carried to the highest pitch, his physical condition, as related to his surroundings while at school, is too often neglected.

The Inspection of Food and Drugs.

The reports of the analysts of food and drugs embrace the work accomplished during the year 1884. The first half of the year includes the work done under the appropriation of $5,000, the same amount as that of the preceding year. The work of the last half of the year was done under an appropriation of $10,000, by which increased facilities were given, and a much greater amount of work was accomplished. The department of collection was established in a more uniform, systematic and thorough manner, so that all parts of the State should receive the protection afforded by the statutes.

There can be no question as to the beneficial results of the law as executed by the officers of the Board, in improving the quality of the food and drug supply of the State, especially in regard to milk and butter, — in the former case as relates to the quality of the supply, and in the latter as relating to the proper branding and marking of spurious goods. The extensive correspondence of the Health Department with wholesale houses outside of Massachusetts also confirms their appreciation of the value of the work done in this State, and also the necessity of furnishing articles of undoubted purity for this market. This is especially true of all classes of drugs sold at wholesale by parties outside the State.

* Second Annual Report of the State Board of Health of New York, 1882, page 189.

The actual economic results obtained by the enforcement of the statutes relative to food and drug inspection cannot be stated exactly. The law is comprehensive and its provisions cover a great variety of articles. Its restraining influence extends outside of Massachusetts to manufacturers sending goods to this market. Such parties appreciate the value of the work done in this State, and also the necessity of furnishing articles of undoubted purity for this market. It is specially provided by the statute that at least three-fifths of the amount appropriated shall be expended in the enforcement of the laws relating to the adulteration of milk and its products. This provision has been carefully observed, as the reports of the analysts will show.

The principal articles liable to adulteration are milk, butter, spices, vinegar, cream of tartar, and various sorts of drugs. The value of these articles specified at present consumed in the State may be stated in round numbers at $15,000,000 annually.

It may safely be stated that the enforcement of the statutes has resulted in a saving to the consumers of at least 5 per cent. of this amount or $750,000, a sum equal to seventy-five times the amount expended in the enforcement of the laws.

The Weekly Mortality Reports of Massachusetts Cities and Towns.

The statistics comprised in this report were compiled from the returns furnished to the Health Department weekly by the cities and large towns of the State, about one hundred in number. They show the prevalence of infectious diseases, their relation to the total number of deaths from week to week and also for the year.

To these statistics for the year 1884 have been added the mortality-rates of the principal cities of Massachusetts for each week during the year, the results being expressed in a tabular form, and also by means of charts or diagrams which present these statistics more clearly to the eye. These are given in groups of cities of similar populations.

The Relation of Illuminating Gas to Public Health. A Study of the relative Poisonous Effects of Coal and Water Gas.

The papers relating to illuminating gas are presented as containing the results of recent investigations upon the subject of its poisonous effects upon persons exposed to its influence, when escaping unburned from service pipes, street mains, burners or otherwise. The recent introduction of a new illuminating agent into some of the large cities of the United States, and the recent proposal to amend the Statutes of Massachusetts, so as to admit of its manufacture in this State, have led to the present inquiry with reference to the sanitary aspect of the question.

The researches of Professors Sedgwick and Nichols were undertaken for the purpose of determining the relative toxic effects of the two gases as manufactured for use. It is definitely settled that the noxious ingredient of illuminating gases is the carbonic oxide, of which coal gas, as ordinarily made, contains from 5 to 9 per cent., while water gas contains from 25 to 30 per cent. Although the amount of carbonic oxide in the latter is four or five times as much as it is in the former gas, the actual danger, as shown by experiments made, is in a still greater ratio, with exposure under similar conditions.

These observations are confirmed by the inquiries made by the health officer, as to the actual fatality in cities and towns using illuminating gases in the United States. The two cities of Boston and Baltimore, of nearly equal population, afford a fair illustration. In the former, using coal gas exclusively, there have been but four deaths from asphyxia from inhaling illuminating gas in twenty years or more. In Baltimore, in the same period, there have been nineteen deaths from the same cause, seventeen of which have occurred in 1883, 1884 and a part of 1885, or since the introduction of water gas as an illuminating agent.

The table on page 274 also offers conclusive data in the same direction. Water gas had not been largely introduced previous to 1878. During the thirteen years of record previous to that date, the number of deaths from illuminating

gas inhalation, as reported, was 27. In the seven and one-half years of record since 1878, inclusive, the number of deaths reported had increased to 159. The date was not stated in three cases.

So rapid an increase could not be explained by the increase of population, since the population had not doubled in the time specified.

DEATHS REPORTED FROM ASPHYXIA BY ILLUMINATING GAS IN U. S. CITIES.

	1865-1877.	1878-1885.
Number of deaths, ...	27.	159.
Number per year, ...	2.+	21.+

The tables also presented with reference to the comparative mortality from similar causes in England and in the United States also lead to a similar conclusion, that the general introduction of a new and more dangerous illuminating agent has been followed by a largely increased fatality in consequence of its use.

In further confirmation of the observations of the experts employed by the Board, are the results recently published by Dr. Paul Bruneau in a similar line of inquiry. A question having arisen as to the toxic effects of propylene, one of the constituents of illuminating gas, Dr. Bruneau made several experiments to settle the question, with the following conclusion from the results observed: "We may conclude that propylene is only an inert gas, without toxic effect." He also concludes that the effects of illuminating gas upon animals are similar to its effects upon man, and that its poisonous element is clearly and beyond question the carbonic oxide.*

EPIDEMIC CHOLERA.

The design of this paper has been mainly to present a brief sketch only of the invasion and progress of the disease

* Empoisonnement par le Gaz de l'Eclairage par Paul Bruneau. Docteur en Médecine de la Faculté de Paris. Paris. 1885.

from its home in India, with a more full history of its occurrence in Massachusetts, so far as is shown in the Registration Reports and such local documents as could be obtained. Measures requisite for its prevention are briefly suggested, and the action taken by the Board in its published circulars are also detailed. It is especially shown that the popular interest in the subject is due to its sudden invasion and its rapid progress during a brief period of time. Actually the effects of the disease upon the population are but slight in comparison with other diseases when long periods of time are considered, — cholera having destroyed in fifty years but little more than two thousand of the population of the State, while consumption has in the same time caused the death of more than two hundred thousand.

The importance of a pure water supply, both public and private, whether of river, pond, reservoir or private well, is especially urged.

In view of the possible appearance of epidemic cholera on this side of the Atlantic during the year 1885, the following Resolve was passed by the Legislature in its session of 1885: —

[Chap. 56.]

Resolve providing for the protection of the Commonwealth from Asiatic Cholera.

Resolved, That there be allowed and paid from the treasury of the Commonwealth a sum not exceeding fifty thousand dollars, to be used for the purpose of protecting the people of this Commonwealth from Asiatic cholera, said sum, or so much of it as shall be deemed necessary by the governor and council, to be expended under the direction of the board of health, lunacy and charity, whenever the governor and council shall be satisfied that Asiatic cholera exists within the limits of this Commonwealth. [*Approved May 22, 1885.*

In addition to the sketch presented in the paper in question, with reference to the prevalence of cholera in Massachusetts, the following statement is also given on the authority of Dr. Lawson A. Long, who resided at Holyoke in 1849: "The population consisted mainly of laborers, who had been imported by the Hadley Falls Company to grade the land and dig the canals for that company. The shanties

erected for the use of laborers were located on two or three acres of ground, and placed in rows ten feet apart. At the breaking out of cholera, not the slightest accommodation had been provided for them in the way of drainage, so that all offensive matter was thrown in the alleys or behind the shanties. If any further evidence was needed that cholera thrives in filth, the outcome of this condition of things would settle the question. The Asiatic cholera here found a congenial nest.

"Those who could run away did so; these were the unmarried men; married men with families could not get away, and I remember families of six or seven persons, all of whom died within a week.

"Many died within an hour from the time they were attacked.

"Not a single death occurred at Holyoke among the people, half a mile distant from the infected 'patch,' which was strictly quarantined."

Dr. L. also states an interesting fact relative to the liability to premature burial in cases of cholera. He relates several instances where, at Holyoke, persons supposed to be dead were restored by the application of moist, hot blankets, the supposed corpse being wrapped in them and stimulants administered. Another similar case occurring in his experience in New York in the epidemic of 1854 is detailed in the same letter.*

Disinfection.

Observation and experiment with reference to the comparative value of disinfectants have resulted in defining their actual power as destroyers of infectious material, articles once considered of little value having been thus elevated to a high rank and others shown to have but little actual value. These important adjutants of sanitary work have been made the subject of special study by the American Public Health Association. The preliminary report of the Committee on Disinfection, which is largely the result of the observations and experiments of Dr. Geo. M. Sternberg, U. S. A., are of

* Letter in a recent copy of the New York "Mail and Express," July, 1885.

such value that we have deemed them worthy of publication as a valuable document for public information.

The Sanitary Relations of Taunton.

In this paper, one of a series of articles on the health of the cities of the State, Dr. Jones has given a statement of the principal questions relating to public health in the city of Taunton. These relate mainly to the drainage, particularly of certain portions of the city, the prevalence and control of infectious diseases, the collection and disposal of night-soil and garbage, the registration of vital statistics, and other matters which properly come under the supervision of a local Board of Health.

Health of Towns.

The information given under this caption was obtained by means of a circular addressed to the local boards of cities and towns, requesting replies to certain questions relative to their sanitary condition.

It was deemed advisable to renew this department of inquiry, and it is hoped that it may be rendered still more efficient by the appointment of medical correspondents in different sections of the State, from whom more valuable information may be obtained with reference to the prevalence of infectious diseases and other matters of sanitary importance.

Certain points appear quite prominent in the replies, which are of special importance at present,—the great want of care in some towns with regard to the enforcement of the statutes relative to contagious diseases, and especially the laws relative to vaccination. Since the majority of the population are in early life scholars in the public schools, it follows that the statute relative to the vaccination of school children affords by its careful enforcement an important safeguard to the people, which should no where be neglected. The actual amount of protection afforded by vaccination is illustrated by the statistics quoted on page 238, relative to the comparative fatality among the vaccinated and the unvaccinated children in London.

Our thanks are due to the local boards of cities and towns who have contributed to the report, and especially to those of Boston,* Cambridge, Waltham, Northampton and Lancaster, for valuable information and suggestions furnished by them.

* The discrepancy in the death-rate of Boston, as reported on page 239, and also on page 376, is accounted for as follows: The former is calculated from the State census of 1885, and the latter from the estimate of the local Board of Health.

The following table will be found useful in the interpretation of the centigrade temperatures given in the Reports of the Analysts: —

Table of Thermometric Equivalents According to the Centigrade and Fahrenheit Scales.

Given. C. Sought. F.

$$n^\circ\,C = \frac{9\,n^\circ}{5} + 32$$

Given. F. Sought. C.

$$n^\circ\,F. - \frac{5\,(n^\circ - 32)}{9}$$

C.	F.	C.	F.	C.	F.	C.	F.
— 20.	— 4.	10.6	51.	40.6	105.	70.6	159.
— 19.4	— 3.	11.	51.8	41.	105.8	71.	159.8
— 19.	— 2.2	11 1	52.	41.1	106.	71.1	160.
— 18.8	— 2.	11.7	53.	41.7	107.	71.7	161.
— 18.3	— 1.	12.	53.6	42.	107.6	72.	161.6
— 18.	— 0.4	12.2	54.	42.2	108.	72.2	162.
— 17.8	0.	12.8	55.	42.8	109.	72.8	163.
— 17.2	1	13.	55.4	43.	109.4	73.	163.4
— 17.	1.4	13.3	56.	43.3	110.	73.3	164.
— 16.67	2.	13.9	57.	43.9	111.	73.9	165.
— 16.1	3.	14.	57 2	44.	111.2	74.	165.2
— 16.	3.2	14 4	58.	44.4	112.	74.4	166.
— 15.6	4.	15.	59.	45.	113.	75.	167.
— 15.	5.	15.6	60.	45.6	114.	75.6	168.
— 14.4	6.	16.	60.8	46.	114 8	76.	168.8
— 14.	6.8	16.1	61.	46.1	115.	76.1	169.
— 13.9	7.	16.7	62.	46.7	116	76.7	170.
— 13.3	8.	17.	62.6	47.	116.6	77.	170.6
— 13.	8.6	17.2	63.	47.2	117.	77.2	171.
— 12.8	9.	17.8	64.	47.8	118.	77.8	172.
— 12.2	10.	18.	64 4	48.	118.4	78.	172.4
— 12.	10.4	18.3	65.	48.3	119.	78 3	173.
— 11.7	11.	18.9	66.	48.9	120.	78.9	174.
— 11.1	12.	19.	66 2	49.	120.2	79.	174.2
— 11.	12.2	19.4	67.	49.4	121.	79.4	175.
— 10 6	13.	20.	68.	50.	122.	80.	176.
— 10.	14.	20.6	69.	50.6	123.	80.6	177.
— 9.4	15.	21.	69 8	51.	123 8	81.	177.8
— 9.	15.8	21.1	70.	51.1	124.	81 1	178.
— 8.9	16.	21.7	71.	51.7	125.	81.7	179.
— 8.3	17	22.	71.6	52.	125.6	82.	179.6
— 8.	17.6	22.2	72.	52.2	126.	82.2	180.
— 7.8	18.	22.8	73.	52.8	127.	82.8	181.
— 7.2	19.	23.	73.4	53.	127.4	83.	181.4
— 7.	19.4	23.3	74.	53.3	128.	83.3	182.
— 6.7	20.	23.9	75.	53.9	129.	83.9	183.
— 6.1	21.	24.	75.2	54.	129.2	84.	183.2
— 6.	21.2	24.4	76.	54.4	130.	84.4	184.
— 5 6	22.	25.	77.	55.	131.	85.	185.
— 5.	23.	25.6	78.	55.6	132.	85.6	186.
— 4.4	24.	26.	78.8	56.	132.8	86.	186.8
— 4.	24 8	26.1	79.	56.1	133.	86.1	187.
— 3.9	25.	26.7	80.	56.7	134.	86.7	188.
— 3 3	26	27.	80.6	57.	134.6	87.	188.6
— 3.	26.6	27.2	81.	57.2	135.	87.2	189.
— 2.8	27.	27.8	82.	57.8	136.	87.8	190.
— 2.2	28.	28.	82.4	58.	136.4	88.	190.4
— 2.	28.4	28.3	83.	58.3	137.	88.3	191.
— 1.7	29.	28.9	84.	58.9	138.	88.9	192.
— 1.1	30.	29.	84.2	59.	138.2	89.	192.2
— 1.	30.2	29.4	85.	59.4	139.	89.4	193.
0.6	31.	30.	86.	60.	140.	90.	194.
0.	32.	30.6	87.	60.6	141.	90.6	195.
0.6	33.	31.	87.8	61.	141.8	91.	195.8
1.	33.8	31.1	88.	61.1	142.	91.1	196.
1.1	34.	31 7	89.	61.7	143.	91.7	197.
1.7	35.	32.	89.6	62.	143.6	92.	197.6
2.	35.6	32.2	90.	62.2	144.	92.2	198.
2 2	36.	32.8	91.	62.8	145.	92.8	199.
2.8	37.	33.	91.4	63.	145.4	93.	199.4
3.	37.4	33 3	92.	63.3	146.	93.3	200.
3.3	38.	33.9	93	63.9	147.	93.9	201.
3.9	39.	34.	93.2	64.	147.2	94.	201.2
4.	39.2	34.4	94.	64.4	148.	94.4	202.
4.4	40.	35.	95.	65.	149.	95.	203.
5.	41.	35.6	96.	65.6	150	95.6	204.
5.6	42.	36.	96.8	66.	150.8	96.	204.8
6.	42.8	36.1	97.	66.1	151.	96.1	205.
6.1	43.	36.7	98.	66.7	152.	96.7	206.
6.7	44.	37.	98.6	67.	152.6	97.	206.6
7.	44.6	37.2	99.	67.2	153.	97.2	207.
7.2	45.	37 8	100.	67.8	154.	97.8	208.
7.8	46.	38.	100.4	68.	154.4	98.	208.4
8.	46.4	38.3	101.	68.3	155.	98 3	209.
8.3	47.	38 9	102.	68.9	156.	98.9	210.
8 9	48.	39.	102.2	69.	156.2	99.	210.2
9.	48.2	39.4	103.	69.4	157.	99.4	211.
9.4	49.	40.	104.	70.	158.	100.	212.
10.	50.						

THE METRIC SYSTEM.

Length.

1 Myriameter, . .	Mm.	(10,000 m.)	= 6.2137 miles.
1 Kilometer, . .	Km.	(1,000 m.)	= 0.62137 miles.
1 Hectometer, . .	Hm.	(100 m.)	= 328.0833 feet.
1 Decameter, . .	Dm.	(10 m.)	= 393.7 inches.
1 Meter, . . .	m.	(1 m.)	= 39.37 inches.
1 Decimeter, . .	dm.	(0.1 m.)	= 3.937 inches.
1 Centimeter, . .	cm.	(0.01 m.)	= 0.3937 inch.
1 Millimeter, . .	mm.	(0.001 m.)	= 0.03937 inch.

Surface.

1 Hectare, . . .	Ha.	(10,000 sq. m)	= 2.471 acres.
1 Are, . . .	a.	(100 sq. m.)	= 119.6 square yards.
1 Centare, . . .	ca.	(1 sq. m.)	= 1.550 square inches.

Capacity.

1 Kiloliter or Stère, .	Kl. or st.	(1,000 l.)	= 1.308 cubic yards.	= 264.17 gallons.
1 Hectoliter, . .	Hl.	(100 l.)	= 2 bush. and 3.35 pecks.	= 26.417 gallons.
1 Decaliter, . .	Dl.	(10 l.)	= 9.08 quarts.	= 2.6417 gallons.
1 Liter, . . .	l.	(1 l.)	= 0.908 quart.	= 1.0567 qts. (1.761 imperial pints.)
1 Deciliter, . .	dl.	(0.1 l.)	= 6.1022 cubic inches.	= 0.845 gill.
1 Centiliter, . .	cl.	(0.01 l.)	= 0.61022 cubic inch.	= 0.338 fluid ounce.
1 Milliliter, . .	ml.	(0.001 l.)	= 0.061 cubic inch.	= 0.27 fluid drachm

Weight.

1 Millier or Tonneau,	M. or T.	(1,000 Kg)	= 1 Kl. or 1 Cu. m.	= 2204.6 pounds (avoirdupois.)
1 Quintal, . . .	Q.	(100 Kg.)	= 1 Hl. or 0.1 Cu. m.	= 220.46 pounds.
1 Myriagram, . .	Mg.	(10 Kg.)	= 1 Dl. or 10 Cu. dm.	= 22.046 pounds.
1 Kilogram, . .	Kg.	(1,000 g.)	= 1 l. or 1 Cu. dm.	= 2.2046 pounds.
1 Hectogram, . .	Hg.	(100 g.)	= 1 dl. or 0.1 Cu. dm.	= 3.5274 ounces.
1 Decagram, . .	Dg.	(10 g.)	= 1 cl. or 10 Cu. cm.	= 0.3527 ounce.
1 Gram, . . .	g.	(1 g.)	= 1 ml. or 1 Cu. cm.	= 15.432 grains
1 Decigram, . .	dg.	(0.1 g.)	= 0.1 ml. or 0.1 Cu. cm.	= 1.5432 grains.
1 Centigram, . .	cg.	(0.01 g)	= 0.01 ml. or 10 Cu. mm.	= 0.1543 grain.
1 Milligram, . .	mg.	(0.001 g)	= 0.001 ml. or 1 Cu mm.	= 0 0154 grain.

One kilogram is equal to a weight represented by one liter of distilled water at 4° C. In the centigrade scale 0 (32°+F.) is the freezing point; 100°+ (212°+F.) is the boiling point. Five degrees C. corresponds to nine degrees F.

All measures in the metric system are derived from the meter, and their names express their values. Some of the names in the French system (like our "dime") are not in practical use; e.g., hectometer, decagram, etc.

One inch = 2.5 centimeters nearly; one quart (wine measure) = 0.946 liter; one pound Troy = 0.373 kilogram; one acre = 0.4046 hectare.

SANITARY CONDITION OF SCHOOL BUILDINGS

IN

MASSACHUSETTS.

By D. F. Lincoln, M.D.

SANITARY CONDITION OF SCHOOL BUILDINGS.

By D. F. LINCOLN, M.D.

In accordance with a vote of the State Board of Health, Lunacy and Charity, an inquiry into the sanitary condition of certain schools in Massachusetts was undertaken in the autumn of 1884, and continued for some months. The points of the inquiry will be detailed presently. The method of seeking information has been limited for the most part to personal visits of inspection and inquiry made by Dr. Lincoln. In many instances, valuable help has been rendered by other persons who have accompanied him upon certain visits, among whom may be specially mentioned Dr. S. W. Abbott, Medical Officer of the Board; Dr. A. H. Johnson of Salem; Dr. J. F. A. Adams of Pittsfield; and the school superintendents of many places.

Twenty-five towns and cities have been visited, and in many cases all the schools have been seen; in the others, a fair selection of illustrative specimens has been made. In each place, the buildings that were spoken of as models (if any) were visited, and also such as were mentioned as discreditable, besides others of average excellence.

A visitation of all the school buildings was made in the cases of Newton and Pittsfield. In parts of Berkshire a considerable number of country schools were seen; and schools of a similar type were encountered here and there in other parts (Brockton, Springfield, etc.).

The following is a list of the towns visited, and the number of schools seen in each : —

Boston,	37	Springfield,	9
Newton,	20	Pittsfield,	11
Brookline,	4	Great Barrington,	4
Everett,	4	Stockbridge,	3
Melrose,	4	Washington,	5
Wakefield,	5	Dalton,	8
Salem,	6	Cheshire,	3
Brockton,	8	Adams,	3
Fall River,	9	North Adams,	5
Nantucket,	7	Williamstown,	2
Worcester,	11	Shelburne Falls,	1
Monson,	1	Buckland,	2
Ludlow,	1		

In this report, no general formal summary, covering the whole ground of school hygiene, is attempted. Each school is reported separately, and, in some cases, a summary of results is given in connection with the town or city, the most extended summary being that of Boston.

It was thought desirable to prepare a series of questions, addressed chiefly to the heads of schools, for the purpose of getting a considerable body of detailed information. Such questions were printed, and, to some extent, distributed; and they have been found a useful auxiliary. But the great part of the information here given was gained by direct personal inquiry, which was found by far the most valuable resource. Teachers are not always able to give sufficient time to fill out a long series of answers. Some, even among the most intelligent, failed to grasp the meaning of certain points; occasionally a blunder was made where it would hardly be expected (as in a question of simple arithmetic); and, on the whole, it was found best to depend on the results of personal visits.

In visiting a school, the points noted may be summed up as follows : —

1. Name, place, size, etc.
2. Site, extent, locality, condition, dampness, neighboring nuisances.
3. A rough sketch of the outlines of one floor of the building.
4. Height, safety of construction, staircases, fire-escapes, etc.
5. Dimensions of rooms, and calculation of cubic space allowed per scholar; appliances for ventilation, and results.

6. Heating apparatus and character of the air supplied; temperature.
7. Drainage and sewerage, and construction and condition of water closet, etc.
8. Description of the seats and desks; windows and appurtenances; blackboards; colors of the walls, etc.; amount of light; type of books, and other matters which may affect the eyes; rooms for clothing.
9. Vaccination; number of cases of contagious disease, and of other affections which may be ascribed to the school influences; length of hours of study and of recess.

General Health of the School Population.

Statistics upon this point have not been attempted. In making visits to schools, questions bearing in that direction were put, and answers of a decided character were noted. It is too much to expect of teachers in general, that they should be capable of judging fairly in respect to the causes of ill-health among pupils of whose course of life they know so little. Some answers to *printed* questions are here given: —

Q. What disorders are prevalent?

A. 1. Nervousness. School not responsible.

2. Headaches; defective sight. When a girl complains of headache, I forbid her to study at home. Defective sight due to school influences.

3. Colds, defective sight, deformity of spine or shoulders. Not ascribable to school work or influences.

4. Headaches, weakness or delicacy, nervousness, not due to school.

5. Out of a school of eighty-seven pupils, twenty-nine complain of headaches; but only *nine* attribute them *partially* to school work. Twenty-nine complain to susceptibility to colds, twenty-three of whom attribute it to defective heating. Three are troubled with deafness, and six with defective sight, only one of whom thinks it due to school work.

6. Headaches, colds; not due to school.

7. Headaches, nervousness; not due to school.

8. Colds; not due to school.

9. Amenorrhœa. The proximity of a marsh is our worst feature.

"Colds" and "headaches" are the points that chiefly attract the attention of teachers in making replies. The prevalence of defective sight among school children has been sufficiently proved by investigations in American schools; but the matter is rarely spoken of by teachers as having any consequence. Most school children, it is true, are too young to have any marked degree of near-sight, and

such as exists may readily escape notice in three-fourths of the classes. No effort to compile statistics upon school diseases was made, as it was plainly undesirable to rely upon written information given in reply to circulars.

Complaints of bad ventilation, and other defects, are often made by teachers, but it is rarely the case that they are able to point out physical illness caused by school life.

Contagious Disease.

It was not learned that any important epidemic had occurred among the schools during the year previous to the examination. As examples of the regulations which are adopted by the more enlightened towns, and which are in principle understood, and applied at discretion by teachers generally, the two following quotations are subjoined:

[From the "General Regulations" of the Salem public schools, chap. VII., sect. 3.]

"*Contagious Disease.* — No child shall be permitted to attend school, coming from a house in which any of the following contagious diseases exist, namely, diphtheria, scarlet fever, or small-pox, during the time such house is infected with either of said contagious diseases, nor until fourteen days after said house shall cease to be infected with either of said diseases.

"And the teachers of the several schools are directed to make semi-weekly inquiries of the scholars under their charge as to the existence of either of said diseases in the houses from which they come."

[From "Rules and Regulations for the Government of the Schools of Wakefield."]

"XVII. — No pupil shall be admitted to any public school till he has been successfully vaccinated or otherwise secured against small-pox, nor without a permit from the committee; and no scholar shall be allowed to attend public school while any member of the household to which such scholar belongs is sick of small-pox, diphtheria, or scarlet fever, or during a period of two weeks from the death, recovery, or removal of such sick person."

Study.

The amount of study and recitation has been lessened of late years. At present, in most places, the daily sessions are three hours long in the forenoon and two in the afternoon, with recesses of various length. In Newton it has been thought best to abandon the recesses (giving only so much time as is absolutely required), and the hours there

are from 9 to 11.30, and from 2 to 4. This arrangement is liked. In Pittsfield the sessions are from five and three quarters to six and a quarter hours daily.

In hardly a case is study at home required before the age of twelve. High schools usually have a single five-hour session, with recesses. The Prince School (Boston) has the same, though it is a grammar and primary school.

Physical Development.

In no place was the reporter more struck with the apparent deficiency of the physical frame, in girls, than in some of the Boston schools. At the age of from twelve to sixteen girls grow very fast; at the same age their studies are increased in amount, and they cease to romp freely. They grow up slim, round-shouldered, and occasionally twisted. The sight of an upper grammar school class of girls is far from satisfactory; and more especially is this the case when they are seen writing, with a different individual bias towards deformity or weakness showing itself in each case. It is not merely unsatisfactory — it is positively painful — to see the crowds of weakly looking girls whose minds are supervised with judicious care, while their bodies are left neglected.

Calisthenics are practised in the schools; but it is probable that they do not produce much effect upon the general muscular development. They are performed in a confined space, and but for a few minutes at a time; the range of movement is quite limited. They serve the purpose of a sort of recess, giving a better diversion from book work than is often enjoyed by girls, who are inclined to dawdle in hot rooms or puzzle over books when they should be playing. A good-sized hall, free from encumbrances, a few simple apparatus for free-hand work, and good teachers (special teachers are desirable) are necessary for producing the results that are required.

The practice of military drill seems to be gaining in popularity in schools. It is generally thought to be useful as a "school for the citizen-soldier;" this point is contested, but lies outside of our range. If we compare a class idling away a long recess, lolling and gossiping, with a class under-

going military drill, the advantage is in favor of the latter, with its demand for promptness, attention, and order, its spirit and interest, and its vigorous activity. It may be, however, that the chief use of the drill has been to prepare the way for something better in the way of physical exercise, for the "manual of arms" is not a good developing exercise; it consists of cramped, forced, limited, and one-sided movements, and requires a good deal of "setting up drill" to counteract its bad tendencies.

From several most trustworthy sources come complaints of neglect on the part of janitors and janitresses. The matter, in some cases, is really of serious importance; schools ought to teach order and neatness, and not set examples of filthiness and neglect before the eyes of children.

Some further remarks of a general nature in regard to lighting, ventilation, security from fire, and drainage are placed in the report on the Boston schools; and discussions regarding some points in ventilation may be found under Salem and elsewhere.

Boston.

The buildings occupied by schools in Boston number one hundred and seventy-five, of which thirty-seven were visited, chosen so as to represent all sizes, classes, and conditions. Those that are decent and well-kept are greatly in the majority among the list of those visited. No special effort was made to select poor specimens; the buildings were usually visited in groups — a grammar school first, and then the primaries associated with it. Several buildings, however, were visited for the express reason that they are pointed to as models.

The list of buildings is so arranged as to place the best and newest first. There are seven such. Then come two High schools; and then a series of eleven important buildings (from the "Quincy" to the "Chapman") representing the type which for many years dominated in school architecture here — that with four rooms on a floor, and a corridor with two stairways between, forming nearly a square; a compact and convenient structure, usually four stories high.

The plan representing this type is seen in figure 1 ("Dwight"). A modification is seen in the "Andrew."

Then follow a series of mostly antiquated structures, many of which are ill planned, poorly lighted, unwholesome, and undesirable in many ways. I do not state, however, that all of this class are unwholesome. In several there is no distinct danger to health; though in others there certainly is such danger. The places that are most likely to be neglected are (as far as I have seen) those which lie among the homes of the poor; as in the neighborhood of the northern and southern depots, and South Boston. An excuse for this is partly furnished by the fact that the population seems in some cases to be dwindling; and it seems hardly worth while to rebuild for the sake of a few score children. A want of acquaintance with the general scope of the plans of the School Board prevents me from discussing this question further. The primary school buildings are more open to objection than any others.

Light. — As regards the lighting in the Boston schools, we may divide the rooms into three classes: —

1. Rooms badly shaped, so that the light fails to reach the interior parts fairly (Tyler Street).

2. Rooms lighted in the most strictly scientific way, exclusively from the left, and by a rather high light. Such rooms are rarely found. See plan of Boston Latin-High School.

3. Rooms in which light is introduced from all available sides except the front. This is the case in most of the new schools, and in a majority of all. Compare remarks under the Dorchester-Everett school. It is well to say here, that in many places the danger that light will be cut off by surrounding houses is so pressing, that no considerations of the theoretical advantages of "unilateral lighting" can be allowed to hold place, compared with the need of *light at any rate.*

Rooms which have light on only one side possess the distinct advantage of a full illumination for all the blackboards. A well-made room of this class has a pleasing and satisfying aspect; the scholars are never forced to look towards the light for any purpose, and the teacher is not obliged to sit

facing windows — a very trying position. There are very few school-houses in which some of the blackboards are not placed between or at the side of windows, and this is a very undesirable position. The use of shades to roll up from the bottom relieves the eye in such cases.

One Boston principal believes that the use of the *maps* furnished to scholars is always bad for the eyes. Very great improvement has been made in late years in the print of school-books, but in one respect matters are still very bad; I refer to the small-print dictionaries that scholars use for their own study.

The schools of Boston are sufficiently provided with windows, except in very rare cases. When built, they seemed well lighted; but the growth of population has surrounded them with houses of much greater height than was customary at the time of their erection, and in consequence, most of them contain some rooms which are very poorly lighted. It must be borne in mind that the light which suffices for a dwelling-room does not suffice for a school-room. A dwelling-room is thought light enough, when the occupants can work in comfort near the windows; a school-room must be serviceable to its farthest corners. The following remarks upon lighting are in detail: —

Prince. — Corner lot; ten out of the twelve rooms sunny; light abundant.

Latin-High. — Typically good.

Dillaway. — The building faces north, and the sunlight is chiefly expended in the corridors and hall. There is no want of light, except that the shade of trees sometimes interferes.

Dorchester-Everett. — The rooms are planned to receive light entirely from left hand; but owing to trees, etc., it has been necessary this year to cut a rear window in each room, to throw light into one rear corner. The teachers think the change an improvement. The building stands within thirteen feet of the sides of the lot, but the light is obtained from the front and rear by very wide windows.

Benjamin Pope Primary. — Abundant.

Savin Hill Primary. — The same.

Dorchester Avenue. — The same.

Dorchester High. — The same.

Charlestown High. — In one room, used for drawing, the light is bad.

Quincy. — A stable 30 feet high stands within four feet, and interferes seriously with the light in four rooms. The lot might have been bought before the stable was put there, two or three years ago. The same inconvenience may occur on the other side. The lot is too small to secure good light.

Wells. — Some very fine trees on two sides shut off much light. In the rear stands a house 25 feet distant, and on the side another, 15 feet distant, and as high as the school-house, cutting off much light. Gas has to be used during the last hour (3–4) in half of the lower story, and it would be a great convenience to have it in the second story. One room has too few windows.

Everett. — Even here the four lower rooms are interfered with by 3-story houses, distant 40 and 60 feet.

Starr King. — Light reflected from neighboring brick buildings pains the eyes.

Winthrop. — The same complaint in the rear aspect. On the north-east a house stands 20 feet distant, 10 feet higher than the school, and extending far beyond to front and rear. On the south-west a 7-story house recently built produces a considerable loss of light, even at 50 or 60 feet. Gas is used in four rooms, and one teacher sometimes uses it at 9 A.M.

Phillips. — A church, six feet distant, cuts off half the light of four rooms.

East Street. — Deficient in one room at times.

Eliot. — Two rooms very dark; in one, pupils' faces often cannot be distinguished, and gas is used a large part of the time, P.M., until March. The house abuts on three sides on streets about 20 feet wide, with houses 30 to 40 feet high; the fourth side has a wide yard.

Lawrence. — Sufficient.

Brimmer. — Lot narrow; house on one side, distant 12 feet; house on the other side 7 feet, four stories high, extending 20 feet forward and backward of the school.

Wait Primary. — Fair.

Chapman. — Good; closets dark.

Andrew. — Good; site prominent, surrounding houses small.

Dean Ungraded (Wall Street). — Poor; block of houses 40 feet distant, 40 feet high; rooms low.

Somerset Street Primary. — Mostly good.

Emerson Primary. — In one room "they can hardly see after $3\frac{1}{2}$ P.M.," for two months.

Grant Primary (Phillips Street). — Has only about 40 feet square of unoccupied land. Cellar used as playground; requires gas. Light in rooms not bad.

Bowdoin. — Light poor in two lower rooms on dark days, P.M.

Pormont Primary. — One room dark.

Freeman. — Some rooms are "dark from 3 to 4, even on a fair day, in winter." On the east stands a block of 4-story houses, distant 16 feet; on the north, houses at 25 feet; on other sides, less close.

Ware. — Some rooms dark at $3\frac{1}{2}$ P.M., on bright days, owing to proximity of houses. The windows measure three by six feet only. On two sides there is ample yard space.

East Street Primary. — Disused for the last few months; was in use when visited. Its west side is covered by a high building 18 feet distant, and on the east stands a school-house distant in part 12 feet. The darkness was extreme in some rooms. In five rooms it is too dark except on sunny days; one was poorly lighted at noon on a bright day. The clothes rooms are almost perfectly dark.

Tyler Street Primary. — Deficient in two lower rooms. Is in contact with dwellings on both sides, which project several feet in front and rear.

Andrews Primary. — No fault found.

Way Street Primary. — In one room it is quite dark for a month in winter from 3 to 4; for a week "they cannot tell the time by the clock across the room."

Mather Primary. — Two rooms sometimes very dark.

Parkman Primary. — Four rooms dark.

Dorchester-Everett Primary. — Not bad.

The *ventilation* of the Boston schools, with scarcely an exception, depends mainly upon open windows. As for the "systems" which have been introduced, they are not by any

means all failures, but they are all inadequate. Many schools possess good wooden or brick flues, well arranged, and in successful operation; the only point in which they fail is their defect in size — a great defect, however, as may be seen under the head of "Quincy School."

An uniformity of plan can be seen in many schools, in respect to this form of ventilator. But a want of uniformity is equally seen in the fact that these flues are not of the same size; that some few buildings have none; and that in some, serious faults have been committed in the arrangement. (See "Dorchester-Everett.") A few rooms have been provided with "Excelsior" ventilators. The "Gouge system" has been tried — and with some effect — in at least one school. Holes pierced in the walls of the room opposite to steam heaters have been tried, and proved troublesome and ineffective. Boards, to be placed under open windows to deflect entering currents of air, have been supplied to a good many schools; to some, *one* per room, to others, *two;* while many have *none.* Transoms over the doors of rooms are valuable aids; they are usually found, but in a number of cases they are wanting. The distribution of double windows is very far from impartial. In fact, the existing condition of the buildings is a standing monument (in spite of many changes) of the inferiority of those of old time, and of the unsystematic way in which steps have been taken in the line of improvement.

A very important change has been begun within the past year, namely, the introduction of forced ventilation by steam fans into several houses now building. Credit is due to the present city architect for this step, which was taken in accordance with the advice of Dr. Billings. An engine of 4 horse-power, with a fire-pot 14 inches in diameter, runs two fans, one for propulsion, the other (at the educt shaft) for expulsion. The cost for the plant, for a house of eight rooms, is said to be $2,800; the engine can be safely run by an average janitor, and the cost for fuel is trifling. The success of this measure will be a great credit to the city, for all systems dependent on heated flues for the sole motive power are at times ineffective. In the case of one new schoolhouse, a test of the power exerted in moving one of the fans

gave as a result 2.014 horse-power. The calculated power of the machine (disregarding friction in the flues) is such as to enable it to extract all the air from the school-rooms and the play-grounds in the cellar once in four minutes.

SECURITY AGAINST FIRE.

The mere fact of the destruction of a school-house by fire is of little consequence, compared with the terrible results of a panic. A panic in almost all cases is totally groundless. There are very few schools from which, in case of fire, the entire mass of pupils cannot be safely discharged in two minutes, if they will keep cool. The first thing to be done is, then, to practise the children in drills, so that at a given signal they may all participate in an orderly movement to the doors. The next thing is, to inspire confidence in the minds of the teachers and pupils, by assuring them of the security of the part of the building that they occupy. In order to give this sense of security we may build the stairs and corridors so that the flame cannot ascend, and the rooms so that the flame cannot pass, except very slowly, from one to another. This is the present intention of the Boston inspectors of buildings. No house has been built according to this plan, but it is hoped not only to apply it to new buildings, but by degrees to extend it (as regards the fire-proofing of rooms) to the old ones.

A part of the plan for preventing a panic is to let the smoke escape as rapidly as it forms by means of a great valve in the skylight, and also by special flues in the brick walls communicating with the floor-spaces below them. It is also very desirable to build corridors and staircases fire-proof.

DRAINAGE AND WATER CLOSETS.

Of the schools visited, eight (according to my best information) are provided with privies of the old type — pits without overflow. "There are now 123 vaults, more or less of the old style; some are connected with the sewers, others not. There are 27 flushing vaults [cemented vaults containing water, let off daily], and the remaining buildings are provided with water-closets." This quotation is from the report of the City Board of Health for 1884–5. The report fur-

ther states that the annual inspection during March and April, 1885, showed an improved condition of the school buildings. Of the whole number of 175, 143 were in good sanitary condition. In 23 the drainage was defective (chiefly sink drains); in two the privies filthy and neglected; in three the cellars were slightly damp; in six the urinals were slightly offensive; and the vaults were not found offensive in any case. No sewer gas was perceived in any building.

"Frequent complaints have been made from time to time by teachers and other persons, who claim to be very much annoyed by the offensive odors arising from vaults. Quite a number have not been cleaned for years. The storage of fecal matter for years in school-house vaults seems to be open to grave objections as to health, and the sooner the practice is discontinued the less the danger to health."

The *Prince* school-house (Boylston, corner of Dartmouth Street) is a representation of a new type of buildings, which includes the Latin-High school and the Dillaway. It was dedicated in 1881. It has a lengthened front, with southerly exposure, displaying the long side of four rooms, and a main entrance in the middle; behind these rooms a corridor runs the whole length of the building, and in the rear of the corridor, at the corners, are two more school-rooms. To the six rooms correspond six on the second story; a hall for assembly is placed over the main entrance. The house is two stories high, and rather simple in style. The corridor is very light, and has doors at each end and at the middle. Eight of the twelve rooms are corner rooms. The plan is, therefore, well suited for natural ventilation.

There is no uniform prescribed system in the Boston schools for regulating what may be called the sanitary routine. There is, however, a commendable degree of interest felt by the heads of schools in the health of those placed under them.

The Prince school is, in a certain way, the most prominent — being filled with the children of the best-known citizens, and standing amidst a group of the best private schools in the country, some of which profess peculiar hygienic advantages. For this and other reasons it is mentioned first.

The building is furnished with brick flues in the walls;

but, as no provision is made for heating them, the draught is not regular; in fact, some of the lower orifices in certain rooms have had to be stopped, on account of the occasional annoyance from *descending* draughts. This being the case, the chief reliance has to be placed upon the windows and the transoms over the doors of the rooms. The north windows are double, with movable sashes, and it is the practice to keep these constantly open — the outer sash at bottom, the inner at top. The draught from these windows is not thought to be injuriously felt. The remaining windows are less constantly open; though they may be opened at the teachers' discretion, they are usually closed in winter, except at the airing-out time. The session is five hours long (9–2), and is broken by five periods for ventilation. Calisthenics are practised at 10, 11½ and 1½, five minutes each time, and during the exercise the windows are open rather wide. (The pupils do not have time to leave the rooms. There is no music at the exercise.) In addition to these three periods for ventilating, there are two recesses, one of 10 minutes at 10½ and one of 30 minutes at 12.10, during which all the scholars file out into the basements, where they remain under the immediate control of their own teachers. The basement story stands clear above the level of the yard. During this time the windows and doors are kept wide open. Two children are sent to the different rooms, five minutes before the close of each recess, to shut the windows preparatory of the return of the scholars. Leave to play out of doors is granted in favorable weather.

The thermometer is recorded daily by each teacher at 9 o'clock, and the record is preserved by the master. This is not required by the school board. As a general result, there is a temperature approaching within one degree of 70°, seldom falling below 68° or exceeding 72°. This result may indicate a certain delicacy of constitution or habit. It may be compared with the statement of the head-master of the Lawrence school, who has never found his pupils uncomfortable at 65° or 66°; but those are boys who have to "rough it" at home.

There was a failure in some of the inlet flues for supplying fresh air to the steam-coils, at the west end of the house,

the current often being reversed, so that in very cold weather the valve has to be closed and the supply of air taken from the cellar. This, however, is only done in the morning, before school begins, when the air is pure.

The yard is too small for a playground; when used, it is occupied only by the younger children. If the latrines were placed in the yard, they would crowd the space considerably. In point of fact, the cellar (basement) under the present watchful supervision of teachers and janitor, seems to be a suitable place; at least, there is now no offence perceived by a scrupulous observer. The head master and his male assistant occupy stations near the boys' urinal when in use. A part of the good result is due to such care; a part to the fact that the children are well bred; and in fine, the apparatus itself has been repeatedly improved, until at present it is satisfactory. The urinals are of the best slate; the latrines are troughs of masonry containing water, and discharged daily (flush-tanks); they are ventilated by pipes which draw properly; burning gas jets assist greatly in producing a strong draft.

The result, as regards ventilation, may be considered fairly good; satisfactory under the circumstances.

Mr. Young desires to add that on three days in the week one class at a time devotes half an hour to exercises in the hall, consisting of marching, free-arm movements, and dumb-bell exercises, to the sound of a piano played by a teacher, the teacher of the class being on the floor with them. The course is planned by the master, and his intention is to extend it, having already seen benefit come from it. This is a reform greatly needed in the schools.

Latin-High. — This building is three years old, and represents the same ideas that are embodied in the Prince school; viz., corridors well lighted; rooms mostly on one side of the corridors; rooms chiefly lighted from the street, and in most cases lighted from one side only,— a plan suitable for buildings with a central open square. It is not necessary to enlarge upon the other peculiar features, — the great size and extent of the structure, the very large drill-hall and gymnasium, the two assembly-halls for the respective schools, and other points which would find mention in a special

architectural report. A few matters of direct sanitary interest should, however, be presented. As regards ventilation, the brick walls contain flues, intended to be kept heated by steam pipes, and of a capacity equal to that of the inlets for hot air from the heaters; that is, large enough to afford eight cubic feet (or exhaust eight cubic feet) of air per minute per head. This allowance is not at all such as is now considered adequate. It must also be conceded that the application of heat for exhaustion of foul air might be made in a less wasteful way. In point of fact, I believe that the heat is not so applied. The ventilation of the building is substantially natural ventilation, for which its construction well fits it. The annexed plan shows how abundant are the means of communication between the rooms and the corridors. The windows have the peculiarity of a separate tilting sash at their heads; this sash is not of use in cold weather, but is admirable in summer. The rooms that are poorly ventilated are certain ones so placed that they have but one door. When such a door is closed, the air very quickly grows close. The assembly-halls, also, are not very well ventilated. The light is very satisfactory. The water closets are in turrets, semi-detached from the building; they are of good construction; the urinals have occasionally been noticed as smelling badly.

The same allowance of eight cubic feet was made in the case of the Prince school, in which, likewise, the use of steam coils for heating the flues has not been practised owing to its cost. In the Prince school I believe the pipes have not been inserted.

Dillaway. — This school was finished in 1883; its plan differs from any other in the city. Briefly described, the first floor resembles generally that of the Prince school, except that the master's room in the rear is omitted; and the length of the building is lessened by putting two offices in place of the two middle school-rooms found in the Prince. Thus there are four school-rooms on a floor. In the second and third floors the middle space is occupied by a large and lofty hall. The closet room is excellent; the stairs secure; the corridors spacious. Ventilation is aided by keeping transoms (over doors) open, and by occasionally (not regu-

larly) opening double windows; but the flues (two in each room, fourteen inches square, brick, straight up through stack in roof,) are thought to play the chief part in giving a good result. The rooms measure $24 \times 34\frac{2}{3}$ feet = 832 floor-space = 15 per head. Apart from considerations of ventilation, this is said to crowd the pupils laterally. The room is, in fact, 3 feet 8 inches *narrower* and 2 feet five inches *deeper* than a typical school-room of the older type (Dwight school). Indirect heating is used in the class rooms; direct radiation in the hall. In all the rooms the light enters only on the left hand of the pupils. In the upper rooms the windows are made smaller by being curtailed at the bottom, intercepting the view of the street. This is not much liked, but the amount of light seems to be sufficient. Trees darken three of the rooms somewhat. For about 650 girls only 13 water closets are provided, of which five are inconveniently placed. The number should be considerably increased; and it is hard to see why it was slighted at first. The lot is large enough, and the situation is good.

Dorchester-Everett. — Contains ten rooms and a hall, in three stories. It was dedicated in 1877 and represents a step in advance of the old four-square type (Dwight). The change in the arrangement is not very great: the chief point of sanitary interest is the fact that the entire light is taken from the left side of the pupils. The house stands within thirteen feet of the sides of the lot, but the light is derived from the front and rear of the house. A concession, nevertheless, has been made by theory to necessity; it was found that, for one reason and another (partly owing to the great number of shade-trees), more light was required, and within a year a rear window has been added in each room to light up a dark corner. This is reported as giving satisfaction.

The stairs are excellent, the entries spacious and light. The rooms measure $25\frac{1}{2}$ by $32\frac{1}{2}$ and are 13 feet high, a little under 15 feet floor space and 210 cubic space: the windows are $3\frac{1}{2}$ by 9, four on a side, so that the ratio of window to floor is about = 1 : $6\frac{3}{5}$ exclusive of the rear windows, which would be considered liberal.

The ventilation is dependent on a system of brick ducts which cannot be relied on, owing to the bad arrangement of

the flues in the attic. They converge by tin pipes to a large wooden shaft at the highest point of the roof. I felt a strong *down* current while standing in that shaft. The pipes, in converging to the shaft, are greatly bent; six of them were bent at nearly a right angle, and six others made one exact right angle and two others one of 45° ! In the school-rooms, at the same visit, the current at the ventilating registers was descending in about as many cases as it was ascending. A teacher with whom I spoke said that she kept her windows open, except when the wind was east; then she had to close them and the air grew very bad. The furnaces were going at the time of visit; the air from them was affected by the cellar air. In the division of the cellar where the girls' water closets are set, there are six boxes containing steam coils for heating the rooms, located directly over the water closets; these (or most of them) were *standing open* at the time of visit to take in the cellar air for the school supply. As a rule, the valves which admit pure air from outdoors to the boxes are *closed*. The cellar air did not seem to be remarkably pure; it partook of the school-room odor. The cellar is paved with soft brick, which makes it dusty.

Benjamin Pope Primary. — There are eight rooms in this new building, of which three are occupied by an average of more than 60 children each. The plan is peculiar; the effect pleasant. The windows are on the left and rear, the rooms being all alike. There is very little to find fault with. But in one room a teacher informed me that a certain ventilator did its duty so well that she did not require to open the rear windows in that corner of the room. On further inquiry, it appeared that she supposed the opening of the windows to be intended as a regular part of the system, and indeed, if she got her impressions from experience in most of our schools, she was not far out. But in regard to the flue in question, there certainly was an error, for it was throwing down a violent stream of cold fresh air, in a way that could not have been safe to the neighborhood. The cellar seemed neat, high, dry, and well lighted.

Savin Hill Primary. — A pretty, wooden, two-storied house, just opened; one room in use. The rooms have light on *three* sides; but the teachers' eyes are spared by placing

the windows in the opposite wall near the corners. Rolling shades of a pleasant drab tint are used. The outhouse is near, but detached, with covered access. It stands over a cesspool.

Dorchester Avenue. — This building has been occupied but a few months. The outside is rather ugly but it is very pleasant inside. There are two stories, four rooms; a fine airy corridor and stairs; cellars remarkably good, entirely above ground, very light, all cemented. The rooms are lighted on three sides, just as in the Savin Hill, except that the end windows are raised, so that their sills are about seven feet from the floor. This is very desirable from one point of view. The ventilators did not work satisfactorily; the pipe takes a right angle bend in the attic and runs to a box that is cracked, under the ridge pole; the steam-heating, which was intended, had not been completed — a pipe led *to* but not *into* the box.

Dorchester High. — Site fully sufficient. A neat and pleasant building. The plan comprises three large class-rooms, two ordinary class-rooms and two smaller ones; it seems to be suitable. Ventilation not good without the aid of windows. Water closets in cellar (latrines).

Charlestown High. — The yard is very small and the boys play in the streets at recess. The plan comprises some very large study-rooms (one on each story) and recitation-rooms to correspond. The site is elevated, and want of light is not complained of except in the drawing-room. The temperature at visit was above 70° in most parts. There is one ventilating flue (a foot square internally) in each small room, and two in each large room. However inadequate this provision may be, it seemed to be performing its duty. Closure of all the doors and windows in one large room (44 × 41 feet) arrested the upward current, which recommenced vigorously the moment a window was opened. The supply of fresh air for the heating apparatus (steam coils in cellar) is taken directly from the street, at the level of the ground, and is sometimes dusty. Automatic hopper-closets in the cellar. Urinal (in cellar) objectionable in construction, quite dark, ill ventilated — a current of air often descending the tube.

Quincy. — Of the square type; four stories; four rooms

on a floor except the upper one, where half the space is taken by a hall. The ventilation is of the sort found in all or nearly all of this class. In each room there is one wooden shaft, 16″ square, leading straight to the attic, where all the shafts converge at a proper slope to two great wooden boxes which discharge upward by a metal cap. Each shaft is independent of the others, and has openings at the floor and ceiling of the room it ventilates. There are also boards placed under window-sashes to facilitate and make safe the raising of windows. In the entries the windows are usually open at all times; in the rooms, at recess and after school.

An experiment was made with the anemometer, upon a day cold enough to have furnaces lighted, in October. The figures are the average of the results of five observations taken near the centre and the four corners of each opening. The aperture near the ceiling being closed, the lower opening exclusively was tested. First story, north room (unoccupied, cold) velocity = 80 feet per minute; south room, 112; same with windows and doors closed, 87: second story, west room, 73: third story, south, 84; west, 71: fourth story, in great hall, 41. This observation gives an average rate of about $[(112 + 73 + 84 + 71 + 41) \div 5 = 76]$ 76 feet, and an exhaust of 134 cubic feet per minute per room, or less than $2\frac{1}{2}$ per scholar. These inferences are probably not far from the truth, in moderately cold weather, not only in the case of the Quincy school, but in all the schools that are similarly ventilated. It would not be too much to say that it is desirable to secure ventilation to ten times the extent here indicated; or, 25 cubic feet per head and minute, instead of 2.5. Doubtless the velocity of the currents will be doubled in very cold weather. In consistency with this result is the observation of the master, — "I think the ventilators are generally disregarded — we don't depend on them at all — they are simply left open." No fault is to be found with the construction of the apparatus; it is only inadequate to the discharge of its duty.

The rooms on one side measure $30 \times 26 = 780$ floor feet, on the other, $31' 4'' \times 25' 10'' = 809$ feet. The height varies from 13 feet in the three lower stories to 16 in the upper

story; giving per head, allowances of about 14 floor feet, and 181, 188, 214 cubic feet.

The windows are of fair size $= 3' 10'' \times 8' 9'' = 33\frac{1}{2}$ square feet, giving the ratio of glass to floor surface = about $\frac{1}{6}$. There are transoms over the doors. The clothes-rooms are of sufficient size. The general aspect of the interior gives a favorable impression. The privy is in the yard over a trough which discharges into the sewer; there is sometimes a bad odor, though none was noticed by me.

Wells. — A girls' school of 600 pupils. Ventilators of usual wooden pattern; air current reversed! The windows are kept much open, and any scholar may close them without asking, when incommoded. Heating, by boxes of steam coils in cellar. The janitor is much disposed to open the valves in the boxes so as to supply them with cellar air, at the same time closing the proper, that is, the external inlet. The object gained is the saving of coal. The master exercises frequent oversight, and controls this abuse for the most part: a few years ago it formed an intolerable annoyance, the air of the house being sucked down to the cellar and sent up again in continuous circulation. To some extent (viz., in the entries) this now takes place. Light deficient. Water closets all in cellar, and said to be entirely unobjectionable; they are provided with heated ventilator flues. The lot is too small to secure proper light at the side and rear. This is illustrated in figure 8.

Everett. — An imposing building of four stories, fourteen school-rooms and a hall, on a large lot (220×160 feet) running from street to street. The rooms measure $32\frac{1}{2} \times 27\frac{1}{2} = 894$ floor feet $= 16$ (and nearly 200 cubic feet) per scholar. There is a little overcrowding, not exceeding 62 pupils to a room (normal standard, 56). The ventilators resemble those in the Quincy school; the draught was strong at my visit (October 13). The windows are opened thoroughly at recess (though some teachers are careless about it) and at the end of the sessions; also usually during the calisthenics, at 10 and 3. "The chief dependence, beyond all question, is placed upon the windows. With great care, we keep the air reasonably pure; it depends on the weather; we must be fighting all the time. We have the school-room doors

open at all times, for moral as well as physical reasons." The house is heated by steam boxes in the cellar. In mid-winter, sometimes, when the wind is very strong, these boxes are opened internally. The master "has a standing disagreement with the janitor on the subject; the janitor has the boxes shut off from the outer air three times in ten that I go to the cellar." The privies are in the yard at a distance, and rarely give trouble.

Starr King. — A primary school of three stories. Lot about 140×85. The rooms measure $28 \times 26 \times 13$, giving floor space $= 13$ feet, and cubic space $= 169$ per scholar. There are wooden flues, but they make two right-angled bends in the attic before reaching the upright discharge-shaft, and they have a long horizontal course to make. The draught is very feeble, and sometimes descending. Some of the rooms contain steam-coils, without screens, in addition to indirect heating. About fifteen feet in the rear stand the sheds; there is no light except what comes through a heavy louvre screen in the front; there is a *dummy* ventilator on the roof. There is a nuisance from the (wooden) urinals, sometimes perceived in the house.

Phillips. — Four stories, neat; cellars light, high, and neat; privies (in yard) better than usual; general impression good. Ventilators as usual; wooden. "Chief reliance on a skilful use of the double windows, in connection with the flues." Some rooms are over-full. The size is $30' \, 4'' \times 28' \, 6'' \times 12' \, 4'' = 10{,}662$ cubic feet $\div 56 = 190$ nearly, per scholar. The air not quite good; some teachers rather neglect the opening of windows. Some poor water closets in the house. The neighborhood is noisy; the house abuts upon the sidewalk on two sides. There are some poorly lighted rooms.

East Street. — The building is situated in the "South Cove," upon made land of poor quality, through which the tide probably flows. The population is largely composed of the poorest classes, but, owing to the building of warehouses, it is diminishing; hence, some of the rooms are not full, and some are unoccupied. The house was built in 1860, and is a pretty good one, having three stories, and three rooms on a story. Most of the rooms are sunny, and (perhaps for

that reason) there was said to be some complaint among teachers of trouble with their eyes. A very old school-house stands twelve feet distant, which interferes with the light in one room. A bridge connecting the upper stories of these two serves as a fire escape. There is much annoyance from the passing of heavy teams. The rooms are 28′ 10″ × 28′ 3″, and are lighted from three sides; the floor-space = 814 ÷ 56 = 14½ feet per scholar; but 45 is a more usual attendance in full seasons. There are no double windows, transoms or window-boards: each room has one flue: windows are opened at morning recess, once during each session for exercises, and after school.

Eliot. — The room doors are kept open to the corridor for the sake of air; windows are kept open, and those in the corridor are opened systematically. There are also ventilators. The yard is large (50 × 100), and the old fashioned privies (connected with the sewer, and washed out two weeks ago) were not offensive.

The Lawrence School is on nearly the same plan, but has no crowded rooms, the allowance being nearly 200 cubic feet per head in all. In this respect, the large schools of this class are not very far apart from each other.

The ventilation resembles that in the Brimmer; there are window boards at each window, and four radiators in each room; and in one-half of the rooms, two of these radiators are furnished with holes (9 × 11) for fresh air, with valves, several of which are broken and are very hard to reach for repairs. There were also tin casings placed over these radiators, but these were removed as inconvenient. There are also wooden flues, drawing pretty well; but the chief reliance is upon the windows, which are ordered to be kept open at top. The light is sufficient. The privies (cleaned four or five years ago) were offensive, the urinals (of wood) smelled badly.

Winthrop. — The lot is rather large; the site was originally good but is now objectionable, for Tremont Street has grown very noisy, the houses on all sides have been raised, and there are various odorous trades in the adjacent Eliot Street. Another complaint is that of excessive reflection of the sun's rays from numerous brick walls and windows.

One great deficiency in the plan is the absence of cloak-rooms; the entries have to serve the purpose; the latter are dark, and so are many of the rooms. The ventilators measure 8×16, one to each room. The cellars are decidedly damp, although the site is on rising ground. The privies stand about forty feet from the house, over common vaults, discharging to the sewer by outlets at about half their depth. They were flushed with a hydrant a few days ago, before which they were very offensive (as would naturally be the case in September). The last cleansing had taken place in December, and the one before that a year previous.

The Brimmer School represents in rather an unfavorable form the old type of school-house, of which a considerable number are still standing in Boston. It is formed on the four-square plan. It is four stories high; the stairs are too narrow; the light in some rooms is bad; there are no clothes closets, so that the clothes hang on pegs in the school-rooms; and the privies are objectionable.

The yard is bricked, as usual, and is abundantly large, containing five or six thousand square feet. The lot, however, is so narrow that the school-house is overshadowed by dwellings, which on one side are four stories high, stand within eight feet of the school, and outflank the building by twenty feet in front and rear, while on the other side, a three-story house stands within twelve feet.

The privies are in the yard at a distance. I saw the solid contents in one standing within a few inches of the level of pavement of the yard. There is an overflow pipe into the city sewer, which got clogged two or three years ago, producing an overflow into the yard. The vault is said to have been cleaned three years ago. The urinals are painted wooden troughs.

The rooms are heated by steam coils placed in the rooms, without screens. An attempt to promote ventilation has been made by making an opening of 11×9 inches through the walls, opposite to each coil; these openings are often closed, and are very little use. Somewhat more to the purpose are the wooden flues (16×10), one of which stands in the corner of each room, and which seem to draw well. Each room is furnished with boards to place under the win-

dows, to help the ventilation in a well-known way, and in addition, the tops of the windows are usually let down a little.

Room No. 7 contains an allowance of 158 cubic feet per scholar; and a smaller room, intended for 46 boys, an allowance of 164, which is distinctly overcrowding.

Wait Primary. — The lot (Shawmut Avenue) is between two streets; the house stands 25 feet from each, and fifteen feet from the next dwelling. The rooms measure $27' \ 3'' \times 23' \ 4'' \times 12 = 636$ floor, $7,632$ cube $= 136$ cubic feet per scholar, one of the lowest ratios found in Boston. The urinals are placed in the cellar; they are well made, and not offensive when visited.

Chapman, East Boston. — This is a grammar school of the four-square type, with an extension across the end of the entry. The old rooms are like the average; the new ones are pleasanter. Some of the water closets are placed in the cellar, others in the yard; there is complaint of the latter; the janitor's work is neatly done. The heating is on the direct plan. There are small wooden ventilators, and three eurekas in each room. The light in the clothes-rooms is very poor, being almost entirely dependent upon opening the doors.

Andrew, South Boston. — Built in 1877 (figure 3), on a plan derived from the Dwight type by extension: the corridors cross. There are six rooms on a floor instead of four, and so one-third of them have strictly unilateral light. Mihan's ventilation is introduced. Each room has two pipes, which discharge in the attic to three exits, the section of which is about 90 square feet, which, under favorable circumstances, might discharge 450 cubic feet per second, which would be good ventilation. I am not prepared to state, however, the actual result.

The floors are fire-proofed by having six inches of cement under them. In each story there are two hoses on reels, ready for immediate use. They are under seal, and therefore the janitor has never tested their strength. The cellar is light, and is mostly above ground: it contains the latrines and urinals, which are ventilated by two heated flues in a

fairly satisfactory way. Complaint is made that ashes are not removed often enough.

Grant Primary. — An old house, on a corner lot, with mere bits of yard. The children have to use a damp cellar to play in, and play by gas-light; the stair leading to the cellar is dangerously dark. The stairs to the school-rooms are narrow and steep. The girls' water closet is new and good, needing only a larger supply of water. The boys' privy was extremely offensive at the time of visit. It has no connection with the sewer. *Disinfection* with copperas is occasionally practised, producing relief for a few hours. There is complaint of draughty stairs, and of frequent colds. Ventilation by windows only. Clothes hung in the entries. First story used as a ward-room. One of the most undesirable buildings. (See figure 9.)

Somerset Street Primary. — Formerly a dwelling-house. The rooms are rather low, giving a rate of 139 and 153 cubic feet per scholar (allowing fifty to a room). Each room has a wooden ventilator, 12 × 16 inches, and ordinary open fire-places; more use might be made of the chimneys; the air is tolerable, the light in one room deficient. Play-ground ample, containing nearly 4,000 square feet.

Emerson Primary. — An old pattern, resembling a pair of dwelling-houses. The door is in the middle, opening to a curious staircase, divided by a rail in the middle. The light in one room is bad: the next houses are nearly in contact with the school and jut out beyond the front about twenty feet. One room is complained of as very cold; a record kept showed that it was often below 60°, and on one day ranged from 40° to 60°. The house has an exposure to severe winds on the north side. The ventilators work the wrong way. There are window-boards. The rooms measure 31′ × 21′ 4″ × 11′ 10″, which gives the very small allowance of 140 cubic feet per head. The windows are on the two shorter sides, which makes a bad arrangement. The day was warm (September 17th), and a fine breeze was blowing full upon one side of the house; nevertheless the air was rather close in the rooms generally, owing to the fact that the curtains were kept down to exclude the sun. The janitress was complained of, as neglecting the furnaces.

Another part of the premises spoke ill for her — the privy was befouled at almost every seat. The vault is of the common kind.

Bowdoin. — Site good, but too restricted. The play-ground is 72 × 30, but almost the whole of that is in reality a kind of open cellar, or covered yard, under the north half of the house, which receives scarcely any sun. There are three stories, two rooms on a story; free communication between each pair of rooms, and a stair at each end of the house. In one room the heat was too great (76°); in others 68°. The flue in the master's office was tested; it drew well. There are six recitation rooms, of which four are in use: they are over-crowded, and very close, having but one ventilator in each, and two windows, both on the same side of the room. In the smallest room the ratio of air space was about one hundred cubic feet per child. There were twenty-one pupils reciting in that room, of the age of ten and thereabouts.

Dean, Ungraded. — The site (Wall Street) is on the new land near the northern depots; a poor filling, a soil constantly damp. Water often stood in the cellar of the adjoining house; since the new sewer was built, however, this is less often the case. The neighborhood is low, poor and dirty. It is intended to transfer the scholars to a building in Blossom Street, not yet finished. The building consists of two dwelling-houses, with the entries adjoining; there are three stories, six rooms, all of a size, 21′ 6″ × 25′ 10″ × 10′ 8″ = 5,858 cubic feet = 105 cubic feet to each of fifty-six scholars.

The rear light is interfered with by a brick block, about forty feet distant and forty feet high. The air for the furnaces is taken at the level of the street in front. In the rear there is a yard paved with brick, about eighteen feet wide, and at the back of that is a row of privies which have an overflow connection with the sewer; the retained mass is washed out twice a year with hose. There is generally a bad smell. The urinals are not suitable. The clothes of the children are mostly hung in the entries; there are small closets, also. As a safeguard against fire, the partition between the two entries is cut through on each story. Fire

has occurred in the cellar from a defective flue; if it were to happen again, it would be possible for smoke to appear on both stairways.

The premises are cramped and noisome, the rooms low and dark, and it is discreditable that they should have been so long tolerated.

Pormont Primary. — Six rooms in three stories. Inefficient brick flues for ventilation. The room was close (October 3d); it was said that opening the windows admitted a bad smell from the privy, which had not been cleaned for at least four years; liquid coal-tar and copperas are used. One room too dark.

Freeman, Charter Street. — Three stories, six rooms. The house is surrounded by houses which cut off much light. The blinds are of dark wood. Curtains are wanted. The girls' privy had no windows; was very dark, and was fouled (a very rare occurrence in this city). The teacher ascribes this to want of room. The janitress is complained of as careless.

Ware. — Situated on the same lot as the Eliot, and therefore sharing in the benefit of the space. Between the two houses is the yard belonging to the Eliot, measuring about 45×95; and continuous with this is one belonging to the Ware, of half the size. But there are two rooms that are darkened by adjoining houses. There is much annoyance from heavy teaming; also, complaint of bad smells at the sink and the hot-air register. School has had to be dismissed on account of this, for a day or half a day. The air is taken in at the street level. The privies seem in order. The plan is antiquated; it comprises a stair, two rooms, and another stair, in one long parallelogram, with no communication between the rooms on the second floor.

East Street Primary. — This is one of the oldest and worst buildings in the city. The plan is originally bad, consisting of an oblong, so cut up that the rooms receive the chief light from the ends. The end room on the first story is 36′ 8″ long and 17′ 4″ wide — more than twice as long as wide; while the height is only 9′ 7″. With two windows in each end of such a room the light must be poor at any rate; but the surroundings are such that most of the rooms are

quite unfit for use, for want of light. In the room described the floor-space was about $12\frac{1}{2}$ square feet to each scholar (26 boys, 24 girls), and the cubic space = 122 each. The attendance is often larger. There were in this house twelve rooms used for school purposes, with thirteen teachers, besides two kindergarten rooms (somewhat better than others), and a "baby's school," for the very young children of poor mothers. There were sixty-two of these little creatures in *one* room of the dimensions above stated, situated on the lower floor, damp, and exceptionally dark. The visit was made on a sunny day; but on a dull day the room must be like a cellar. Its recommendation is, that it is allowed to be used *gratis!* Certain small ventilators go straight up, and are capped, and draw; others go out directly through the walls and then turn up a few feet along the outer wall, but (as might be expected) these do not draw well. The air is very poor in the rooms. The privies are within nine feet of the house; they have old-fashioned vaults, and are offensive, though washed and swept weekly; they were said to be occasionally fouled. This is one of the cases in which the pupils are "better off at school than in their own homes." It is said that the absences are most frequent during January and February, owing to poor clothing.

(It is proper to add that the school has been discontinued since the above was observed, only a kindergarten now remaining in it.)

Tyler Street Primary. — The lot is very small. The school-house touches the dwellings on each side, and is overlapped by them; the yard measures about 15 × 60 feet. (See figure 15.) The rooms are badly proportioned, and light is not well distributed. There are six rooms, in three stories. For security in case of fire, the one staircase in the middle is not the best arrangement. There is occasionally some annoyance from the stables next door. The fresh-air inlets for the furnace are near these stables. The cellar is concreted, and is used as a playground. Sometimes surface water comes in. One school-room is damp. In the cellar are new latrines (tanks), through which water flows; the urinal has a continuous current of water. They are ventilated by a flue reaching to the top of the house; a teacher

is constantly present at recess; there is no nuisance. The ventilation of the rooms is aided by weak ventilators, but chiefly depends on the windows. There are no double windows, or transoms: the latter would be of little use, opening into such narrow entries. The rooms are $35\frac{1}{2} \times 20$; average attendance forty-five. The shades or blinds darken the rooms too much. The walls are covered with *yellow* paper. Some of the desks are too small. There are no mats. The unusual statement was made, that within the past year there had been eleven cases of scarlet fever, five of measles, four of diphtheria, and eighteen of whooping-cough.

Andrews Primary. — An old school building of three stories, with stairs at each end, making a complete turn before reaching the next story. There is complaint of smell from sinks; and of deficient warmth in winter, owing to neglect on the part of the janitress. There is a broken water-closet. The privies and yard are neglected; offensive smell.

Way Street Primary. — A small house with three rooms, of sufficient size. Light poor. The tide is said to come into the cellar sometimes. The yard is quite small, the privies, twenty feet off, are in a very foul state, and occasion frequent annoyance to the school.

Mather Primary. — An old structure, originally containing a single large room on each floor, now cut up into four rooms. It is not a desirable house. The rooms measure $33' 9'' \times 19' 3'' \times 12 = 7{,}800$, or nearly 140 cubic feet per head. There are twelve rooms in three stories; there are two steep staircases. Ventilation chiefly by windows; ventilators poor. Some rooms are dark; all the windows are small. The cellar is damp, sometimes wet.

Silver Street Primary. — An old-fashioned, ill-ventilated, ill-smelling house with six rooms in three stories, in an alley. The yard is small, the rooms mostly dark, and hot in summer.

Dorchester-Everett Primary. — A peculiar plan. Four rooms on two stories. Eureka ventilators. No special fault noted.

Newton.

The report from this city is favorable. Every school building was visited, making twenty. As the city is rapidly

growing, the number of new buildings is large; one was incomplete when visited, two had been occupied but a few weeks, and plans are now under consideration for doubling the size of one of the old ones. The city is the residence of Mr. Dickinson, the Secretary of the State Board of Education, who has shown a great interest in the last named plan, and has been urgent in his request to me to aid him by pointing out (if possible) some existing building which could be considered a model for imitation in that case. As something of this sort may be expected in this report, it is well to say that no such model has been found, though a number of excellent buildings have been seen. Reference may be made to the report for 1884, printed in 1885, of the State Board of Education, in which two plans are given with some general remarks on school buildings.

Thanks are due to Mr. Thomas Emerson, Superintendent of Schools, for the great interest shown and pains taken in assisting inquiries. The town is in a state which may be called transitional; partly surburban, partly rustic in appearance, it is rapidly transforming its buildings, and introducing aqueduct water, but has no means of discharge for waste except by the use of cesspools. It is hoped that this incongruity may soon be remedied by the introduction of some system of sewerage.

Of the newest buildings it may be said that they are not beyond criticism, though they are among the best seen in the State, and are admirable in many ways, being well-lighted, roomy and attractive. Among the older ones, most do not exceed two stories in height; there is one built on the old four-square plan; two on the "steamboat" plan; several on models that have passed out of date, and there is one (the Prospect Street at the Upper Falls) which presents a good type of the simplest form of a four-roomed house. The High School is not at all a desirable model.

No attempt was made in planning these buildings to secure unilateral light; many of the rooms receive light both from the rear, and from the right or left (it seems to be indifferent which); many are lighted from the two sides, or from the sides and rear. Defective light was found in Nos. 3, 4, 6, 8, 14, 18, 19.

Ventilation is effected in various ways, but always with the aid of windows. The eureka ventilator is found in many schools, which consists of an oblong opening in the walls, having a valve, and so shaped that a current of air entering will be likely to be deflected upwards. The testimony of teachers was conflicting; some thinking them useful, others useless or dangerous.

The Hamilton School reports the use of the eureka, and of boards put under windows, and of systematic opening of windows. "The pupils stand, face the windows, and the four boys stationed at the windows open sashes at top and bottom. This is done about five times in four and one-half hours. Kept open from one-half minute to two minutes according to the weather." Some such plan is worthy of recommendation in every school, with scarcely an exception; compare the account of the Prince School in Boston.

The following points are noted in individual schools: —

1. *Underwood.* — Four rooms, two stories. Ventilation is particularly poor in winter. No flues; eurekas; transoms. The air for furnaces is taken at a point opposite to the privy. The latter is ten feet from the school, is very dark, has direct communication of air, by a lattice, between the boys' and the girls' side, and an inferior urinal; it should be removed farther, or remodelled in modern style. The light is very abundant, and there is great exposure to the sun. There are two sets of curtain shades, of different colors, which together hinder the passage of air through windows; blinds are needed. Since the visit, an appropriation of $2,000 for new water closet has been made.

2. *Bigelow.* — The ventilation is effected by a plan recently introduced. There is a common central shaft of wood lined with tin, carrying the hot-air pipes for supplying the rooms. The air enters near the ceiling, at a temperature of 100°, by an opening of 20 × 35 inches, and is exhausted near the floor, passing to the shaft mentioned. The result is good. The fresh air supply to the heaters is regulated by a swinging door. The fuel required for seven rooms during the winter of 1883–4 was sixty tons. Excelsiors were formerly used, and caused troublesome draughts. The Robin-

son ventilator is shown, having been used at an earlier date; it used to "work both ways." The privy is old and dark, and ought to be replaced.

3. *Lincoln Primary.* — A two-story, two-roomed building, a queer, old-fashioned structure. There is complaint of insufficient light, due partly to the fact that the windows are four feet from the ceiling, partly to excess of shade from trees. Complaint is made of a damp cellar, or of an unwholesome quality in the air of the cellar.

4. *High.* — Built 1874–5, on a bad plan, and since enlarged; three stories. Ventilation chiefly by windows. One large room has some good-sized flues. Warmed by furnaces. Several rooms are too large, especially the great hall, which is sixty feet across, and lighted from the sides, so that for purposes of study it cannot be properly lighted. An adjoining room seats seventy-four pupils at desks without crowding, and measures $35\frac{1}{2} \times 44' 10''$; it is lighted by three windows on the shorter side, whose combined aperture equals less than half what is desirable, aside from the unfavorable position. In another room the circumstances are nearly as bad.

5. *Claflin.* — An old and undesirable plan which is to be enlarged and remodelled. The entries being on the south side receive much sunlight which could be better directed to school-rooms. One school-room has no sun in winter. The trees interfere with light, and light is deficient in all the rooms but one. One school-room in the third story is *very* deficient. Two large flues have lately been provided for ventilation, one in each half of the house; in these flues run the tin pipes for hot air, and the point of exhaust is under the teacher's platform, thus making a system like that of the Underwood, with good results. In the proposed enlargement, open fireplaces are to be introduced for ventilation. The water closets are iron sinks with water, of a good style, in an outside building reached by a closed passage from the cellar, warmed with hot water, and ventilated.

6. *Adams.* — A three-story wooden house with six rooms. Much attention to personal cleanliness. There is soap and a towel for each room, besides other toilet appliances. A vol-

untary society aids in securing clothing. The ventilation is not good, except as windows are used. Eureka ventilators. The cellar is a little damp, and some flues were found that led from the cellar to certain rooms, presumably once intended in some way for ventilation. The air for furnaces is taken from opposite the privy, which is ten feet distant, and ought to be removed, being a nuisance where it is.

7. *Jackson.* — This is built on what is called the "Steamboat" plan. There are two rooms on a floor, not contiguous, but separated by the section containing entries and stairs. There are two staircases, projecting to right and left, beyond the line of the house representing paddle-boxes. Clothes are hung in the central space between the staircases. The provision of two stairs, thus placed, has its value in securing absolute safety of escape in any ordinary case of fire; though the stairs are not of a good pattern. The windows are too small, and too low, and one room was certainly dark. The privy is reached from the cellar by a short double passage. It touches the house, and causes some annoyance, though its construction is good and modern.

9. *Pierce.* — Much effort has been made within two years to improve this and the two following. In two, the vaults have been removed to a distance; they were formerly almost in contact with the house. In the Pierce, the urinals are carefully constructed upon a very bad plan, with a quantity of woodwork.

10. *Franklin.* — Steamboat plan. Eurekas not much thought of; in one north room one has to be closed in rough weather. The urinal is of wood lined with zinc, a construction often found objectionable. The metal is rotten, the wood soaked. Means for hosing out daily ought to be supplied. Reconstruction will probably be found desirable, and removal to a distance. The privy is so close to the house that the nuisance is sometimes intolerable.

11. *Davis.* — A peculiar, old-fashioned plan, the entrance-end much subdivided. One room is altogether too much darkened by trees. Eurekas not found objectionable.

12. *Williams.* — A new and handsome building in the Queen Anne style, on an original plan. There are but two stories, each having four rooms with southerly exposure;

the corridor is very wide, and occupies the whole north front. There are excellent stairs, one at each end of the corridor. A part of the light for the two middle rooms on each floor is gained by introducing high windows on the side next the corridor. This is necessary, owing to the depth of the room, and the effect is good. In the east room of the first story it was found that light was deficient. This might be improved by changing the position of the desks so as to face westward and to receive the light on the left: but there is also a large tree, which gives more shade than is desirable. Screens are needed to deflect horizontal currents of hot air from the pupils. In each room there is an open fireplace, for ventilation chiefly. The flues that are intended to ventilate are of wood, unlined, and in the attic they form a vast complex of structures which suggest danger from fire. They open horizontally through louvres in a way which does not insure a proper current. The air was, in fact, found coming down one of these flues into a room with a powerful blast, under the influence of wind that struck against the louvre. The water closets in the cellar flush themselves automatically at any interval they may be set for.

13. *Hamilton.* — Eurekas thought well of. The house has three stories, the upper story being a hall. The privies are cleaned monthly; are very neat and free from odor; but are gloomy, and need lighter paint. Urinals badly constructed. Nuisance from a neighboring drain.

14. *Prospect.* — A good type of a plain style. Four rooms; two stories. The corridor separates the rooms; and at each end of the corridor there is a stair, placed at one side so as not to block the passage; there are plenty of windows, and each room has two doors with transoms. One room was too much shaded. Eurekas, distinctly useful in bright, cold days, not in muggy weather. Water closets good iron latrines; good slate urinals.

15. *Primary, adjoining No. 14.* — A fairly good school, if not the most recent type. Large play ground. Water closet in good order, like No. 14.

16. *Thompsonville.* — Temporary primary school in a building that had been a chapel. The privy allows too

ready communication between the sides. There should be a window to it.

17. *Oak Hill.* — Plan not bad. Rooms 32 × 38. Cellar often very wet with surface water.

18. *Hyde.* — Three stories. Hall in upper story, sometimes used for public meetings. It is also used for school work, and for this purpose it is very much wanting in light. The rooms below were open to the same criticism. Eurekas not much valued. Water closets very modern and good.

19. *Mason.* — Light in hall in upper story very poor. Automatic hoppers in cellar. Urinals good, but not wholly free from offence.

20. *Rice.* — Unfinished when seen; is since described as a nearly perfect building. Four rooms.

Brookline.

The schools here seen were in pretty good condition, as a rule.

The *Pierce Grammar School*, 4 rooms, brick, has quite good ventilating shafts.

The *Pierce Primary*, of the same size, is a very pretty building, with rooms rather larger than usual (26 by 37), having, as a peculiarity, a space in the corner of the room set apart as a clothes closet. The water closets are in the cellar, and are altogether too dark; there was an odor about the woodwork.

Boylston Street. — The house is new; the effect is very pleasant indeed. Size of rooms, 26 by 36; lighted on three sides, and the farther corners cut off. Clothes closets are sufficient to accommodate one-half of the children; the rest having to hang up in the entry.

Lincoln. — A two-story school with one room in each story; the plan can be enlarged by building two more rooms on the other side of the entry. Unfortunately, it stands so near the street that there is hardly room to do so without moving the building. There is no platform for the teacher, and this seemed to meet the approval of the lady in charge. The windows are placed above the line of sight, and their shape is peculiar; the effect of all this is pleasing. The

architectural effect is more or less in the Queen Anne style.

EVERETT.

High School. — A good house, overheated at time of visit; condition of the four rooms was as follows: 79°, foul air; 78°, tolerably good; 79°, close; 74°, had just been aired out. Rooms large (36 by 28) and light; cubic space about 300 per scholar. There is in each room one ventilator; some of the flues run horizontally a long distance in the attic, which will impair their working power; in the master's room my estimate of the discharge was 114 cubic feet per minute, a very small allowance. Each room has also an open fireplace with the usual aperture. There is a recitation-room which is liable to become close. Water closet, 30 feet to rear, entered by closed passage from cellar. A communication between the two sides. Urinal offensive; contained lumps of charcoal intended as disinfectant. The day was peculiar, beginning cold and growing quite warm, which may account in part for the report of temperature. But it was rather striking to find such closeness of air in rooms which are so liberal in the matter of cubic space, and are provided with fireplaces and working ventilators.

Centre Grammar. — Forty years old; reconstructed five years ago. Plan simple, but not very desirable. The entries are used as clothes rooms. The stairs are so arranged that scholars from the two upper rooms meet face to face when part way down, decidedly an unsafe plan. Size of rooms, 27 by 35, 12 and 14 feet high. One contains 59, another 71 pupils (13 floor feet to pupil). Blackboards of poor quality. Wooden ventilators, two in each room, communicating with both floors and so exchanging the air from story to story, as was shown by a match lighted below discharging its fumes by the register into the room above. In each room there is one window behind the teacher's desk, in front of the pupils, several of whom are near-sighted. The privies are very near; to shut off the sight of them, a high fence is raised, which cuts off light and darkens two rooms.

Mt. Washington. — A new and good building: two stories, four rooms, two stairways. Defects noted: earthen

floor to cellar, much littered with apple-cores and other trash; the air of the cellar was gassy, and the fresh-air duct was opened so as to take in the cellar air. The upper rooms had not been supplied with shutters or blinds, but had dark-brown curtains, which collected the heat of the sun and excluded light and fresh air. There were *three* closets for clothes, and a part were hung in the entries. There were but eight seats in the privy, and no urinal.

Glendale. — A very old building, probably the poorest in town, and one of the poorest in the county; a type of an old two-story district school-house. The crowding of the pupils was excessive, the cubic space being, per scholar of average attendance, 177 in lower room, 144 in upper and 60 in the recitation-room. The latter measures 11 by 10½, and is 11 feet high, and is occupied by classes of 20 pupils for half an hour at a time. There is no ventilation except by small, low, old-fashioned windows, and naturally "it is very close in winter." The school odor is very marked. The black-boards are inconvenient. There are green shades and no blinds. The staircase is steep and makes two turns. The cellar was nearly full of old shingles, taken from the roof lately. The privies are offensive.

Melrose.

The town contains four larger school buildings (of four rooms and upwards) and several smaller ones. Those visited belong to the former class.

Credit should be given for intelligent progress in the science of building school-houses. The High School, twelve years old, is much inferior to the others, which are more recent, and are good in proportion to their newness.

The plan of the High School is bad; the stairs are needlessly complex, and occupy the whole south front; the clothes closets are long, dark recesses; the play-rooms in the cellar are dark. There are six rooms in three stories; the upper story is directly under the roof, and the thermometer stood at 92° at the time of the visit. The form of the embrasures of the upper windows was such as to shut off much light, but this has been remedied; at present, the teachers are annoyed by having to face large windows directly, and the remedy

applied consists in the use of dark-green curtains, which check the circulation of air, and increase the heat. The ventilation of the house has hitherto been very poor.

The other buildings are nearly alike, though not identical, consisting of a pair of rooms on each floor, separated by a wide hall, with a good staircase at the entrance, set on one side so as not to interfere with the circulation of air; each room has commodious clothes closets. One of them has in each room a large open fireplace (said to be closed in cold weather); all are neat, and the newest is handsome.

The ventilation, however, is not well developed. The flues are quite too small, and the chief apparatus consists of openings in the walls, at about 6 feet from the floors, for the direct admission of cold air. There is an upward bend in the inlet, which is intended to impart a rising motion to the air; but it is doubtful whether this can be relied upon in cold weather. Undoubtedly, a good deal of air enters them at times; for an instance of which, the reader is referred to the report upon the Salem schools. The lighting is effected in the common way, by windows on two or three sides, and the teacher usually has to face the windows.

The High School has ordinary privies, entered from the cellar, and isolated from the house by a six-foot passage. There are also water closets in the cellar. The furnace air is taken at an opening within a few feet of the privies; the same is true in the Highland School. In the Centre Street School there is much complaint of bad smell; there is a trough with water used as a water closet, emptied daily, but there is some failure in the plan. The urinals are objectionable in the three newer schools on account of their construction. Aqueduct water is supplied to all the schools, and the waste passes off to cesspools, there being no system of sewers in the town. The newest school, — the Highland, — has its privy within about six feet of the house; the arrangements are neat, and include a trough containing water, which is to be let off daily to a *settling tank* (within 10 feet of the windows of the school-rooms), whence the overflow is led to a bottomless cesspool at a somewhat greater distance. The soil of the town is gravelly, and the cesspool system may continue to be employed for some time with possible

impunity; but in a region so thickly settled and growing so fast, it ought to be got rid of as soon as convenient.

Wakefield.

Five buildings were visited. Their character on the whole was equal to the average.

The two central schools stand in a very spacious lot, on a moderate elevation, which gives perfect drainage. The paths are very good. In the south building there are four rooms and two staircases; the model is peculiar. The heating was spoken of; coal stoves have been substituted for wood-burners in both these buildings, proving so much more economical that it costs little more to heat both than it formerly did to heat one. The thermometers did not range high, but there was little complaint; 64°, 68°, 67°, 67° at the usual height, while at the floors it marked 59° in the first room and 63° in the others. In each of the lower rooms there was a brick heated flue a foot square for ventilation; in each of the upper ones, two of wood, 1 by 2 feet, suitably capped. The privies are not roomy enough, and the urinals are not as they should be in regard to cleanliness.

The north building has three rooms. Those on the first floor have heated ventilating flues which draw fairly well. In the second primary class the air was tolerably pure, the thermometer at 66°; but in the other (first primary), the air seemed very bad. The temperature 72°; the children were dirtier than the others; the ventilation not well planned. The upper room is twice the size, the temperature 72°; boards so arranged as to throw air directly upon the scholars as it enters windows. The plan of this building has been advantageously remodeled.

High School. — Three stories, with one large and several small rooms in each. The arrangement did not seem entirely judicious. Ventilators of considerable size are found in the large rooms, but there is difficulty in warming. The two recitation-rooms used by the high school are very close, have no ventilators, and contain 24 pupils each, or more; they are not roomy enough. There is a peculiar arrangement of hours, giving a long recess of 30 minutes at noon to enable some of the scholars to get their dinners at the family hour.

There is no doubt that the demands of school are made to conflict with those of nature in many high-school pupils in this State; any arrangement which seeks to remedy this deserves praise.

The master remarks: "Out of a school of 87 pupils, 29 complain of headaches; but only 9 attribute them partially to school work. Twenty-nine complain of susceptibility to colds, 23 of whom attribute it to defective heating. Three are troubled with deafness, and six with defective sight, only one of whom thinks it due to school work."

A great improvement has been made by removing the boys' water closet from the cellar, though the place in the yard is not what it should be. The girls' water closet is in a perfectly close room in the cellar; the room is reached by a very dark passage, and has a penetrating odor which is perceptible in the room above. The apparatus is a flush-tank.

Hamilton. — Built in 1884, of brick, with 4 rooms; neat in appearance. The halls are roomy, stairs good; cellar very well lighted. Each room has 2 wooden ventilating flues, 20″ by 10″, leading by too many turns to a box at the ridgepole, and thence discharging upwards through a louvred cupola. The currents were unequal. A good model, on the whole.

Franklin. — A wooden two-story house with 2 rooms, 12 years old; the model is not modern. There are 4 others in the town built about the same time, 40 years ago. The entry is very dark, and in the others the entries are less roomy. The upper room is rather large, and 14 feet high; it had a neat, pleasant look; thermometer 73°. One small ventilator. Cellar sometimes wet. Privies 13 feet distant; no annoyance.

Salem.

Phillips. — This building is of brick, and has 8 rooms in 2 stories. Its plan is a modification of that of the Dwight school (fig. 2), the position of the stairs, corridor, closets, being the same, and the corners being occupied by four rooms; but one dimension of the rooms is elongated, giving a floor of 26 by 34, and in addition, a little space is left

between each two adjoining rooms, in which ventilating shafts and small closets are disposed. Each room has two such shafts, each 24 by 15 inches internally, and drawing well. One of those in the master's room was estimated by the use of the anemometer to be discharging about 500 cubic feet (515) per minute; the discharge by both would be a thousand feet, or 25 per head for 40 boys. The master thinks very well of the ventilator; his practice is to keep the door closed and transoms over the windows open. The latter measure is necessary, as the heating is by direct radiation by 3 coils in each room. This room is on the first story, and the draught in its ventilators would be likely to be stronger than that in the story above.

The northeast room in the second story was particularly examined. It was said to be hard to heat in cold weather, especially when the wind was high. At the time of visit the temperature inside was 63°. The teacher complains of occasional sick-headache caused by the closure of transoms in cold days. There are also eureka ventilators, or oblique, valved holes in the outer walls, placed two feet from the floor behind two of the steam-coils; the janitor had stopped one of these with paper. In the same room it was noticed that two of the transoms or tilting sashes, placed above the window-heads, were out of order so that they would not move. It is probable that the boiler is not powerful enough to heat the building. Nevertheless, there is a room in the cellar, used upon occasions as a ward room, which was found at the visit to be quite hot, owing to the *waste* of heat from about 200 feet of exposed steam-piping that passed through it.

The window transoms, being a rare feature in school-buildings, attracted attention, and aroused a question as to the draught which might be caused by opening them. They are pivoted on the centre, so that air can enter below as well as above; nevertheless, in order to give favorable conditions to the experiment, the transom in question was tilted at about 40° from the vertical, so that a large part of the air should be deflected upwards. The observer was assisted by Dr. A. H. Johnson of Salem, and both of us found that in these circumstances it was uncomfortable to sit at the desks

in the two rear rows, nearest the window, on account of the descending cold current. With this result may be compared the case of the Boston Latin School, where the transoms are hinged at the bottom, and tilt inwards: here it is impossible to keep the transoms open for more than a few seconds at a time in winter. Further trials made in schools furnished with ordinary windows show that uncomfortable draughts may be caused by dropping the upper sash one or two inches.

In the northeast room a further experiment was made regarding the effect produced upon the draught in the ventilator shaft by closing the various windows. The doors were kept closed, and the "eurekas" were not active at the time. A light silk handkerchief, 15 inches square, was held by two corners so as to hang parallel to and in front of the register of exit near the floor, the high exit being closed. The handkerchief was drawn in so that its bottom edge touched or approached the valve. It was found that when *all* the transoms were shut, and the upper edge of the cloth was held somewhat less than 8 inches from the wall, the lower edge just touched the valve. When one transom was opened, the handkerchief was removed to 10 inches, and its lower edge still touched. When two, or four transoms were opened, the cloth was removed to nearly 12 inches, and still touched; and in the latter case it was found that the upper valve might also be opened without impairing the force of the lower draught. The difference in the force of the currents in the different cases was very great, far more so than the ratios 8 : 10 : 12 would indicate: it seemed as if about $\frac{3}{4}$ of the current was cut off by the closure of the transoms.

The combination of these results illustrates the argument in favor of so-called "indirect" heating. For it is seen here that the ventilator, however powerful, could not remove air from a room in which the windows were closed; and it was further seen (as common-sense might have taught beforehand) that when transoms are opened, draughts of a dangerous character are produced. Hence the inference, that means must be provided for the entrance as well as the exit of air, and that the entering air should be warmed.

These facts are not here insisted upon by way of condemning this particular school, for the condition of things was not found on the whole worse than an average, and indeed, in some points decided credit must be given. It cannot, however, be allowed that this is a "model" school building.

The clothes rooms have no windows, and no ventilation; the light is, of course, deficient; there are transoms opening to entries.

The shades in the school-rooms are of an objectionable yellow color. Blackboards are placed on all sides of the room.

The entrance to the building is too small: a porch is needed. A fence to the play ground is needed for safety. The boys play in a cellar room 36 feet square, sunny, very light and neat, but seeming to lack ventilation. The boys' water closets are 8 of the "artisan hoppers," with automatic action from the seat, two of which were somewhat out of order; they are in a large sunny room opening to the cellar and the yard, but having no ventilation except by two eurekas. The urinals are too low. A more frequent washing of the floor is recommended.

Bentley Primary. — Built in 1860. The windows are so arranged as to give a draught upon the pupils' heads. The arrangement is ingeniously contrived to appear to throw the air up; it consists of a tilting board inserted at the top of an open window. There are small ventilating flues which seem properly constructed. The entries and staircases are not airy, and when the doors are closed they are dark. A part of the clothing is hung in them. The air of the house is close and dusty. The light is defective in one room in winter. There is an attic, into which the close, foul air of the entries rushes when the door is opened; the air in it is unpleasant and dusty; the girls play there in recess. It was stated that the temperature preferred is from 70° to 75°.

Saltonstall. — Eight rooms, 300 pupils, Site good and sufficient. Halls very light and airy. Movable foot-rests are in use. Eurekas, 3 in each room very high up, constitute the sole ventilators, and they are thought well of. Water closets good; urinals too low; neatness; open win-

dows; good light, but dark inner doors; good supervision at recess.

High School. — Brick, two-story, old and not very desirable plan, 212 pupils. Second story consists of 2 large rooms, and the staircases. The first story contains 4 recitation rooms, and 2 very small dressing rooms, which are in need of ventilation. The pupils thus have to descend to their recitations. The air decidedly bad. The boys have 12 recitations per week, the girls 10; this is the result of a change made some years ago when some of the girls were supposed to be injured by over-study. The home study "ought to be at least 2 hours a day." Two hours of preparation are usually required for each recitation, making for the boys 36 hours, for the girls 30, per week, of study and recitation.

Pickering. — Site good and high. Four rooms, two stories. Ventilation by eurekas. The master feels a strong current of cold air from them, and often has to close them; "they amount to the same as an open window." He also opens the windows in every desirable way. The water closets are hoppers; the closets they occupy are dark, as was found in a number of other schools.

Bowditch. — This is a large school, with 12 teachers and 486 scholars. It was built in 1870, and considerable pains were taken to insure a good plan and thorough ventilation. The halls are wide; and the stairs are 5 feet wide, one staircase at each end of the building. With an average attendance of 41 pupils in a room, the cubic space is 261 and 287 cubic feet per head. The standard number is 49; three rooms are usually filled to 52. As regards heating, it is direct. There are openings in the walls of the rooms to let in air, behind the coils. The windows are also kept open with the precaution of placing boards in front. From each room two 18-inch zinc pipes lead to a central brick shaft, heated by a special stove and by special coils of pipe. At the time of the visit, the anemometer indicated an average current in the shaft of 308 feet per minute. The shaft being 5 feet square, the total discharge would equal about 16 cubic feet per head and minute, which is enough to contribute very materially to good ventilation. The impression received

was favorable, but in some cases the air was too warm. In points not mentioned, there is no unfavorable criticism to make.

Brockton.

The scholars of the High School occupy two buildings; the greater part are in the old wooden structure, and the rest in a room called the "Annex" in a neighboring building. This annex is a single, large room, quite low-studded, and therefore sometimes dark, in the second story; it is lighted from the sides. By kind permission of Dr. Abbott, of this Board, the following notes of a visit made by him are here inserted: —

"On Thursday, June 12, I went to Brockton to visit a school building, at the request of Dr. Dean of the State Board.

"In consequence of want of room in the high-school building, rooms were hired by the school committee in a neighboring building. The building referred to is upon the same street with the High School, in an adjoining lot. It consists of the following apartments: a basement, used for police headquarters and confinement of criminals, and also a coach office; the second story contains the police court; the third story contains two school-rooms and ante-rooms used for a portion of the high school; the fourth story, or attic, is used as the headquarters of a Hibernian society.

"As to the condition of these apartments: beginning at the basement.

"The cells of the criminals, all of which (four in number) were occupied at the time of my visit, are partially underground, dark and poorly ventilated. The space in front of the cells is used for the lodging of tramps. The pail system is used for removal of excreta. The drainage of the sink used for washing in this apartment is directly upon the ground.

"The contents of the pails are emptied into the privies, of which there are two — one at each rear corner of the building.

"These two privies are simply wooden annexes to the main building, running up to the third story, and connected with the upper stories by means of wooden shafts of inch boards, which are in places saturated with filth. The vaults are nothing but shallow excavations with stone walls, the natural course of the drainage from which is towards and underneath the floors of the basement.

"One of the vaults, or excavations, also receives the filthy drainage resulting from the emptying of putrefying starch from a neighboring box factory, together with the excreta of about seventy operatives. In the rear of the court-room in the next story is a small, closed room under the stairs, unventilated, where the odor from the vaults was plainly noticed.

"The school-rooms in the next story are poorly lighted, chiefly from one side in each.

"They are also poorly ventilated. The larger has a small but insufficient tin shaft, with opening at top and bottom; while the small room has no ventilation whatever, except by doors and windows. Its light is entirely at one side and also insufficient, its ratio to the floor space being but one-eighth, and that through dirty windows.

"The cubic air space is much less in this room than it should be, especially under the existing conditions as to ventilation.

"The water supply consisted of a water pail, containing about two gallons of dirty water, with a considerable quantity of solid residue at the bottom of the pail."

Since these remarks were made, improvement has been made in the following points:—1, removal of the fecal deposits and the soaked soil; 2, introduction of two good modern water-closets for the use of the scholars. The room itself is open to objection as a place for school work; there are 55 or 60 pupils, and studying and reciting go on at once. The cloak rooms are good.

The old school-house contains 100 pupils. Those at study are usually about 60, and occupy a large upper room, with a poor light, owing to the lowness of the windows. In the lower story there is one room for chemistry, disused for want of suitable ventilation, and two recitation rooms. Drinking-water is kept in pails, which are not always free from sediment. The cellars are out of repair, and not neatly kept. There are no public sewers, and the school has the usual country privy, of the better class, but odorous.

Centre Primary.—Two stories, 2 rooms, wooden: 124 pupils. In the lower room there were 70 of the youngest children present; usual number, 75; 84 is the number belonging; the air was close and dusty. The size was 29 by 23 by $10\frac{1}{2}=7{,}003$ cubic feet, giving 93 cubic feet per head of usual attendance. There is no ventilation, except by

windows. A part of the children recite to an assistant in one of the two little rooms used for hanging the children's clothes. The upper room has a usual attendance of 37 or 38. There is no cellar (the soil is dry). The privies are much too small: they had just been washed out, but there was evidence that they had been defiled. It is perfectly evident that new buildings are greatly wanted, both for this and for the high school.

Sprague. — Two stories, 4 rooms, wooden, nearly new. Site open and sufficient — a two-acre lot. Plan good, in general, but it seems as if the air for supplying the furnace were drawn from the entry. The windows, also, are very low — about four feet from the ceiling. Each room has two doors to the entry with transoms, and one to the clothes room. In one room the air was very close, thermometer at 72°. There is one good ventilator to each room except the clothes rooms. The cellar is dry, and the privies neat and sufficient.

The "Annex," situated at a short distance in the same lot, is an average old country district school-house, with 25 pupils.

Grove Street. — A wooden one-story building with 2 rooms, of a new plan, and rather attractive in appearance. The space is not liberal; the entry is narrow; the cellar doors open directly from the rooms. There are no ventilators, and the airing of the rooms seemed not to be sufficiently attended to. The privy very neat.

Huntington. — New; three stories, six rooms. Plan resembles that of the Sprague. Very large yard. There are no curtains; they seem to be needed. There is a very singular "fire-escape," consisting of two very narrow staircases leading from the third-story rooms, ending in a small room in the second story, but not coming within three feet of the floor; one of these ways was blocked up with apparatus. The ventilating flues are large, but are built on the mistaken principle of having them used in common by all three stories; hence they seem to draw well in the first story, fairly in the second, while in the third they act very uncertainly, and sometimes a reversed current sets back into the room, bringing used-up air from elsewhere. The heat-

ing is direct, by coils in the rooms. The rooms, as might not unnaturally have been expected, were very hot — 70°, 74°, 75°, 79°, 79° and 82° — averaging 76°. Privies as in Grove Street.

Annex to Huntington. — Contains one room, 21 by 22½ by 11=4,720, with 57 scholars, giving 87 cubic feet allowance to each. The house is of a very old-fashioned sort, and very small for the number. The seating accommodations are very poor, consisting of 13 desks, and 47 seats of four different kinds, besides long, high, narrow benches ranged along two of the walls, on which the remainder of the scholars sit or perch as they may.

Fall River.

Bedford Street Primary. — A wooden structure, about 40 years old, having two large rooms and two recitation rooms. This is stated to be one of the poorest schools in the city. There is no ventilation to speak of. The house is said to be poorly warmed; at the time of the visit a large room seemed to be about 60°, and the recitation room adjoining, about 80°. The children sit facing the light. The urinals (in the cellar) have a good ventilator, but are not free from smell; the flush-tank seats were found fouled.

Pine Street. — Not more than 10 years old. It represents in its structure about a dozen of the city school-houses. The plan is compact. The ventilators were mostly found closed and tied, and the windows open. The heating is by a mixed system. There is some offence from the urinal in the cellar. Flush-tanks in same place.

Brown Primary. — Built, 1872. It has 6 rooms, in 3 stories. It represents 3 buildings. There are large flues, the effect of which seemed to be to pour a chilly current into the rooms: they are very peculiar in one respect, as they open at the bottom, not only into the school-room, but also by a trap-door directly into the cellar. The object of this was not evident. The air of the cellars is taken for the furnaces. In some rooms there was complaint of cold. No. 1 was close; 3, fair; 4, tolerable; 5, not full, 76°. In one room the set-basin was complained of as smelling badly; it seems to discharge into a cesspool, and the janitor's son said

there was no trap. The urinals were of copper, and worn out; the privy foul, and of the old fashion.

Davis. — Built, 1873; square plan, 2 stories, good rooms; too warm in rooms; good small ventilators. Heating mixed.

French Parochial School. — Two rooms in a wooden house, each 34 by 23, and 8 feet high. They are greatly over-crowded — 75 and 50 scholars respectively, which gives allowance of 83 and 125 cubic feet. There are no means of ventilation; the seats are plain, hard benches, the desks are old-fashioned. The privy, six feet from the house, has a vault; it is not at all neat. Certainly very undesirable as a school building.

St. Mary's Parochial School. — A wooden building receiving 500 pupils. The accommodation is very poor. One room measures 32 by 19 by 11, and has 70 pupils, giving 95½ cubic feet each. The other rooms are nearly as crowded. No ventilation is provided. The arrangements for heating are poor. The entries are extremely narrow; there is hardly room for two persons to pass. The yard is very small. The privy is 10 feet from the house, and is very small; in summer it is so bad that they have to close the windows in some parts of the house. In fact, these two buildings are the most objectionable that were seen in any town during the whole inspection.

Morgan Street. — This is a large building with 10 rooms, and is rated as one of the best. The cellar is good, but is not neatly kept, being full of old furniture saved for kindling. The ventilation depends chiefly on windows. There are, however, two flues from each room, and of these, 15 were tested, 9 of which were found drawing well, the others slightly, or not at all. There were some putty-joints under the basins in the halls. The privy stands 50 feet in the rear; there is considerable smell; the urinal is an old wooden trough, with an earth floor.

Davenport. — Stands on high ground, is 3 stories high, and contains 18 rooms. The average temperature of the six rooms first entered was 74°. The valves of the ventilators, in all but two rooms, were found shut. The teachers either "never used" them, or did not understand their use — mostly the latter: there is no convenient means of opening

or shutting them, but the construction seems to be good otherwise. The privies were extremely nasty throughout, and the janitor says that the boys leave it in that condition every day. This is not due to deficient accommodation.

Slade. — A new building of 12 rooms, 3 stories high, square in plan. It has an attractive appearance. The heating is by the mixed method, in part by coils in the rooms, and in part by hot air. The ventilating apparatus was not in good working condition. There was no fault to find in regard to neatness, and much to approve in general.

Nantucket.

This town contains seven school buildings; one of these (containing eight pupils) was not visited.

There is no overcrowding, except in the case of the Siasconset school of 21 children, which occupies a very old-fashioned building of contracted dimensions. All are warmed by stoves. Ventilation is accomplished in all by opening windows. Most are supplied with good aqueduct water. There is nothing to boast of in the way of novelty of design, four being simple one-roomed houses, and the remaining three presenting no modern features. Something might be done to improve the state of the outhouses, especially in the Orange Street School.

The Coffin School is an endowed academy of good repute. The scholars study in a lofty room or hall; there are three other rooms, which cannot be considered as quite comfortable or desirable, judged by modern standards — particularly as regards temperature and ventilation.

High and Grammar. — In two stories. First story, four rooms closely contiguous, of which three are in use. Second, one large and two small rooms, also some closets. Windows much too low. Plan of house not desirable, but possessing one good feature — good staircases at each end.

Orange Street. — Two large low rooms, very plain, but with good floors. The windows are small; the pupils have to face the light. Improvement has recently been made; the whole school of 90 children used to sit in one room, but has lately been divided into two classes, and seated in the

two large rooms; at the same time a very gloomy, contracted recitation room has been abandoned.

The school-house at Polpis is a neat and creditable little house; that at 'Sconset is, as before stated, one of the old-fashioned sort, and probably not altogether comfortable. That at Madequet is a bandbox, 15 × 15 × 8, with just room for its eight pupils, allowing 200 cubic feet per head; it was found in very neat order, and possessing a very large stove.

These visits were made in the absence of the pupils.

Worcester.

In some degree the schools of Worcester have a character of their own, especially the newer ones, which have been built during the time of Superintendent Marble. The cellars or basements are usually high, remarkably well lighted and ventilated. Not more than two rooms are heated by a single furnace. The classes are of the usual size. Low ceilings are common; in the newest school they are eleven feet high. There was some fault to find with the color of window-shades. Several cellars have poor floors. The urinals are generally poor, but improvements are going to be made. The new buildings are handsome and good, with very fair ventilation in some cases.

Grafton Street. — A good building. Ventilation by a flue measuring 44 inches outside, divided internally by a brick partition into halves; each half is intended for two rooms. The draught was very strong, and the air in the room seemed good.

Annex to the Same. — An old wooden dwelling-house with two rooms, not very good. The ceilings are too low, and the cubic space per head in one room was 125–130 cubic feet. The cellar has an earth floor and is damp; a draught comes up from the cellar through the defective floor of the school-room. The air was poor in the rooms, though the windows were open.

Providence Street. — An old and not desirable plan; there are four stories. There is a stove in each room, and the windows are generally open. There are also flues. The cellar is damp (with earthen floor), but well lighted. The privy somewhat offensive.

Millbury Street. — A year old. A very neat front of granite and brick. Plan good. Basement high and light. Flues 20 by 42, each serving two school-rooms: draught very good, but windows are also kept open. Good window-shades.

High School. — A large and pretentious building of brick and stone on prominent rising ground. The rooms are very high; the doors opening to the rooms are kept open to the very wide halls, and the air is not distinctly bad, though somewhat close. There is a considerable number of flues, not heated. There is a large room used for drawing by 50 scholars, and once a week by 90, which has no ventilation, and is probably close. The hall in the upper story is rather dark, owing to the lowness of the windows. The chemical laboratory is neither well lighted nor well ventilated. The cellar is very large and badly lighted; it is too wide for lighting; it is used by the boys for play, and is not a very desirable place. The same want of light is found in the water closet in the cellar. The room for the boys' clothes, also in the cellar, is very neat and convenient, but has no ventilation. A point worthy of commendation is the iron platform near the entrance, which is warmed by steam, and serves for the girls to stand on a short time to dry and warm their feet.

Oxford Street. — An old house with recent additions. The cellar floor is very poor; the urinal smells, and affects the air of the cellar. In the basement there is one room still used for school purposes; the situation is undesirable, the light poor.

Winslow. — Two stories, each containing two old and three new rooms. In the latter the ventilation is fairly good, the fresh air being introduced six feet from the floor, and the point of exhaust being at the floor level. The old rooms have ventilating shafts which work the wrong way, causing a downward current; some of them are in the outer walls.

Mason Street. — Brick, two rooms, old style; chimney utilized as ventilator by carrying the stove-pipe in near ceiling, and knocking a hole near the floor.

Woodland Street. — There are two buildings at the same spot which go by this name. The new one is very attractive

in appearance externally. The ventilators are not large enough, and the windows have to be opened. The construction of the urinal is not satisfactory, being of wood covered with metal; and the ventilator acted in the reverse direction.

The older and larger building was furnished with the "Robinson Flue Ventilator," which consists of flues arranged in pairs so that the air is supposed to blow down one flue into a room, and to rise by the other from the room, with no special aid from heat. As far as examined in this building, there was an upward current in almost all cases; in a few, it seemed to be neutral. In most of the rooms the windows were pretty wide open. The ventilators seemed inadequate. The water closets consist of a flush-tank in the cellar. The furnace is close by. The urinal, in the cellar, smells badly.

Chandler Street. — This is an unfinished brick building, ventilated by eureka openings in the walls, and by steam-heated shafts: heated by coils in the rooms. There are ten rooms, measuring 29 by 32 feet, and 11 feet high. This gives a cubic space less than is usual; if the classes are as large as in Boston schools, the allowance per scholar is 182 cubic feet.

State Primary School at Monson.

The more attractive and intelligent children are often removed from the school by adoption into private families; hence, the visitor is struck by the large number of dull and feeble physiognomies seen in any assemblage of the inmates. This circumstance causes a very rapid change of membership in the classes of the schools, and makes it hard to estimate the rate of progress made by classes in their studies. The general aspect of a school-room is not unlike what might be noticed in other public schools in towns where appropriations are not large and the population is composed of the poorer working classes. There are several of these rooms, and the ventilation is tolerably well provided for by flues and windows. The flues seem to draw well. There was a tendency to overheat; one room was quite warm and close. The weather, however, was peculiar, the thermometer having risen rapidly to 50° (December 17th). The rooms are also

well lighted; and, owing to the peculiar arrangement of the hours, they are not at all overfull. Those children who are able to do bodily work are set to it for half a day, and attend school the other half. Some are taught dress-making and tailoring; and each child has two suits of clothes, one for work and one for school — all made in their own shops. Others cook, bake bread, make shoes, make the beds, sweep and clean, and look out for the cattle. It need not be said that this arrangement is very desirable. Throughout the establishment a general spirit of cheerfulness, good temper and good order prevailed.

The diet is very plain. A quart of milk is provided daily for each child; this food is more especially loved by the younger ones, while animal food is more relished by the older ones.

The dormitories, on the whole, seemed satisfactory. One, for boys, measured about $36 \times 38 \times 12 = 16{,}416$ cubic feet for thirty-four single beds, or say 480 cubic feet each. This room had two flues with good draughts, one eighteen inches square, the other circular and twenty-two inches in diameter. Other dormitories have similar or greater allowance of space and ventilation. Some have high open roofs.

The drinking-water is brought by an aqueduct from a pure source; the privies are not specially objectionable; in fact, they have been much improved.

Springfield.

Four of the nine houses visited are very poor, and ought to be replaced as soon as possible by new ones. They are small houses, some of them apparently built for dwellings. In six rooms in these buildings the cubic space per scholar was respectively 165, 143, 125, 141, 80, 114 cubic feet, which is an evidence of great overcrowding — or perhaps we may prefer to say, of insufficient size of rooms — the classes not being too large, but the rooms too small. It happened, also, that in three of the larger buildings visited there were manifest faults in ventilation. If the fraction chosen for visiting represents the average of excellence, the average is not high. A new standard, however, has been set by the Oak Street School, which gives great encourage-

ment for the future. This house is new, light, wholesome, and apparently well ventilated.

High School. — Plan objectionable, as containing some very large rooms, nearly seventy feet across from light to light. The girls' study-room is on the second floor: one who takes (for instance) Latin, Greek and algebra, has to descend three times to recite, besides at recess. There is abundant space in the corridors and study-rooms; and the recitation rooms are numerous. The latter are warmed by furnaces, and the air is better than in the large rooms, which are heated by direct radiation. There are large wooden flues leading to the attic; one was drawing the wrong way. Some of the desks are of a very uncomfortable and undesirable pattern. Water closet good, automatic hoppers discharging every seven minutes. A plan is given. (Fig. 16.)

Worthington Street. — Plan like the Boston Dwight, three stories. Corridors not well lighted; windows in staircases might be enlarged. Ventilation, by flues in the outer walls, not successful. Bad air often enters the upper rooms by the ventilators; in cold weather a cold draught often blows down strongly into the lower rooms, especially at the opening of school. On the first floor, in rooms No. 1 and 3, all the lower orifices were found closed with stout paper, and the upper valves closed; in 2 and 4, all open, the lower ones admitting cold air. Flush-tank, 25 feet from school. The tank is discharged at the end of each school session, and never freezes. The urinal floor is of a coarse absorbent cement, badly cracked; there is much annoyance from smell in the rear school-room.

Elm Street. — Plan like the preceding. There was one ventilator drawing *down* strongly. The brick sheds for flush-tank stand about six feet from the house; the urinals are basins of iron lined with porcelain, and of a very bad construction; the metal is rusty, and it would require a great deal of trouble to clean them, if the attempt were made. They are a nuisance. Heating by direct radiation.

Court Street Primary. — Occupies the first story of an old dwelling-house. One room, 20 by 26, contains 44 pupils, giving 165 cubic feet each; it is very hard to ventilate it, and the children have to be marched around from time to

time while the windows are opened. The light is quite poor. Clothes are hung in entries. The boys' privy is not neat.

Bridge Street Primary.— An old plan, three rooms. It is hard to keep warm in winter. The cellar smells musty; it is a dismal place, with earthen walls and floor; one can see the scholars through cracks in the floor above. The light is not only very badly arranged (scholars sit facing windows), but is poor and inadequate. There is much overcrowding, the cubic space in two rooms being 143 and 125 per head. There is a new and good flush-tank, etc.

Emery Street Primary. — Two stories, three rooms. Old and poor plan. The clothes are hung on the walls and thrown on the floor of the entries. The lower rooms are $25\frac{1}{2}$ by 17 by 13, and contain 40 pupils each, giving 141 cubic feet per head. In the recitation-room in second story, the cubic space is 1,440, and the class may number 18, giving 80 cubic feet to each. There is no ventilation. The scholars face the windows. The privy is dark, is not neat, is an offence to the school and the neighbors.

Oak Street Primary. — This is a *new* building, and stands in refreshing contrast to those just described. The plan is given in the report of the State Board of Education for this year. It is of brick, with 4 rooms in 2 stories. It faces nearly north-northeast, and the entries, stairs and clothes rooms are in the front, so that the school-rooms receive much sunlight. The cellar stands only 2 feet below the ground, and is very light, being fitted with windows of the size used in ordinary rooms in houses. It furnishes very good playrooms. There are two brick flues, heated by smoke-pipes from two furnaces, which exhaust the air from the rooms at the floor level, the escape being through gratings under the platform. At some points the draught could be felt with the hand at the platform. The fresh heated air is introduced at a point 3 feet from the ceiling, as in the Bridgeport, Conn., school. The teachers are much pleased with the results, and think that the rooms do not requre so high a temperature as that to which they were accustomed in the old-fashioned schools, where they used to have to open windows. Their stated preference was for temperatures ranging from 63° to 68°; and any one who is acquainted with schools will

see that this is an unusual fact, as teachers may be said, in general, to prefer from 68° to 70°. A little recitation-room for 8 or 10 pupils is attached to each room; and the cloak-rooms are formed by wooden partitions of half-height in the corridor. The flush-tanks are 40 feet in the rear. There is some odor, owing to neglect of flushing, in the urinals; plan good.

Hooker. — A large, four-square house; entries too dark; cloak-rooms cut in two so as to leave one-half of them nearly dark; they are close and musty. There is considerable ventilation by means of large brick flues. The temperature preferred by teachers was inquired in nine rooms; the answers were "68" once; "68 or 69" twice; "70" twice; "about 70" twice; "70 to 72" twice. The actual temperatures closely coincided with this.

Put's Bridge. — This is situated at a distance from the settled part of the city, and is a plain, country school. A single-roomed, old-fashioned brick building, not badly out of repair. It is but half large enough; the cubic capacity allows 114 cubic feet per scholar. The privy is not locked, and is in a very bad state. At present the school is closed for investigation and correction of drainage.

Ludlow.

In this little manufacturing town, a most commendable example has been set by the proprietors of the mill, by erecting a school for the children of their hands, planned after the most careful study of the subject of school architecture as developed in America and Europe. The result of these studies is worthy of the attention of those interested.

The building contains four rooms in two stories. There are two staircases. Space is ample, though, the rooms being calculated for about 40 pupils, the size of the rooms is not so large as some. The light comes from large north windows on the left of the scholars; but in addition there are south windows, of smaller size, placed high out of reach, and opened at recess to give a flushing-out with air, and to admit the sunlight at proper times. The latter are furnished with blinds. There is a kind of theatre or hall, which will seat some hundreds, not used exclusively by the school, but

intended also for popular lectures for the townspeople. The ventilation is by heated flues of large size. In one lower room the current tested by the anemometer had a velocity of 215 feet per minute, giving a discharge of 610 cubic feet, or about 10 feet per second, the outer temperature at the time being 35°. This is a good result.

Pittsfield.

The schools of Pittsfield were examined with considerable thoroughness, every building being visited, with possibly the exception of one or two outlying district schools. Twelve are reported upon. Several points deserve commendation. There was no case of marked overcrowding; the number assigned to each teacher is kept within moderate limits. Proper regard is paid to the separation of the sexes. There is no study at home required of pupils under the High-school age. The youngest children are sent home at the middle of each school session. The newest school-houses have a neat appearance, and are in certain points distinctly superior to the others. There are two sizes of desks in most cases in each school-room.

On the other hand if the list of faults be drawn out in the same way, it will be found rather a long one. The plans of most of the buildings are rather poor; those of the Orchard Street primary, of the Pontoosuc, and of a new one just building at the centre of the town, are (with exceptions in each case) excellent. Ventilation depends on the windows, to fully as great an extent as elsewhere; flues count for next to nothing. Direct radiation is the general method of heating. Window-boards are needed. Transoms are rarely found, and if they were put in, would be of little use while the entries are so restricted. The clothes-rooms are generally too small, sometimes *very* small; often lighted only by a small transom opening into a rather dark entry; and some are absolutely dark. Light is deficient in several instances, as is often the case elsewhere; but it cannot be said to be from necessity here. The scholars often sit directly facing the light. The water-closets are almost always nuisances; they are placed so near the school-rooms as in most cases to give annoyance, and in some cases they

practically open directly from the school-rooms. Some of the worst cases that were seen in the inspection were found here. This is due, in part, to gross negligence on the part of some persons other than the teachers, a negligence which extends to some other points. There is a tendency in the older buildings to crowd the accessories (halls, closets, water-closets), within a narrow space. Even the High school has that fault. The new Orchard Street primary has the commendable feature of being of one story only. The Pontoosuc is an excellent and roomy building, with fine staircases. The new school-house is to contain eight rooms in two stories, each room being entirely separated from the rest by entries and staircases, which form a Greek cross running through the house. The only feature that was questionable was the very close connection of the water closet, which opens directly from the end of the entry. A plan for ventilating this house, which was proposed, possessed strong elements of unfeasibility. Upon the whole, disappointment was felt at the condition of the buildings. The new houses are greatly superior to the old ones, but there is much to be done for the latter.

It may be that something could be gained by changing the system of ranking among teachers in some way, so that, in each building, it should be understood that a certain teacher is the head or principal of that building. At present the rooms in the same house are entirely independent of one another, as a rule. If such a change were made, the choice should fall upon the teacher who seems to have the most tact in practical business relations, and the clearest judgment in regard to sanitary discipline and police.

High School.—A good-looking, rather new brick house, on a fine site. Corridors and recitation-rooms too small. Direct steam heat; no ventilators. Cellar with earthen floor, not light enough, dirty and neglected. The water closets in the upper story are placed nearly opposite the door of the room in which all the pupils study, and in front of them. Owing to the long session they are in frequent use; they are so near that it is hard to avoid annoyance from smell. The construction of the closets is poor; the drain pipes in the cellar are of sheet metal. In one recita-

tion room, measuring 18 by 16, and 13′ 8″ high, there were 27 pupils (146 cubic feet to each), at a temperature of 72°. In one in the third story (20 by 24, $9\frac{1}{2}$ feet high), the temperature was 81°; there was no ventilation at all. There is another in the same story, of the same dimensions, which sometimes contains 40 scholars; it was still hotter than the last, and the cubic space per scholar was 114 cubic feet. The opening of windows (which is the only remedy) seems to be neglected in some departments. In the main room attention is paid to it.

Elizabeth Street.—Wooden, 2 stories, 4 rooms. Badly built; I saw through the floor of one room from the cellar; in several places, could even catch glimpses of the pupils. The cellar contained a confused mass of rubbish, ashes and paper, and in the midst stood a dismantled brick furnace. The water closets are also in the cellar; those that I saw were automatic hoppers, acting well. The air of the cellar is not good, and contaminates that of the rooms above it. Besides, the furnace seems to be contrived to draw (foul) air down by tin flues from the rooms, and to send it back, warmed. In one room, just after recess, I found the air very unpleasant, like cellar air; the temperature was 72°, being 50° outside, and yet both teachers complained that they felt cold! In the next room the temperature was 66°, with open windows and air blowing on some scholars, but no complaint of cold. In another 76°, the standard of the teacher being "72° in this weather and higher in winter." The fourth seemed to be at 74°—76°. There are ventilators, though small ones. In two of the rooms the pupils face the windows. Two clothes-rooms need windows. The whole condition of the house is not creditable to those who support it.

Union Street.—Wooden, one story, 2 rooms, of good size, light enough. The school is 20 years old, but is well kept up. The water closets are placed centrally, somewhat as in the Orchard Street primary school; there is little complaint.

Centre.—An old wooden building of 2 stories, each containing one large room for study (60 by 40), two recitation-rooms (20 by 16), and the water closets. The situation is

very objectionable, as will be seen by a glance at the diagram (fig. 17). Three engine-houses and the town lock-up stand close to the school. The disorderly element in the school is appealed to whenever an alarm is struck; and the sight of criminals dragged to arrest by the police is forced upon the whole school, if it happens to occur at the time of dismissal. Light is deficient in all the lower rooms. The blinds are dark, and out of repair. In the lower story "the brown shades obstruct air and light." There are no rooms for clothes; the garments are hung in passages and entries, huddled one over another. The water closets are exceedingly dark and inconvenient, especially those given in fig. 18, each of which measures $4\frac{1}{2}$ by $2\frac{1}{3}$ feet, and also contains a urinal; the light enters by the door. How bad the state of things is down-stairs may be guessed from the fact, that the janitor had just spread some chlorinated lime *on the ledge of the blackboard in the school-room*, near the door! In one-half of the closets it is perfectly dark, and in the other half comparatively so, with no direct light. The heating is by direct radiation. It is very hard to keep the heat regulated to a moderate degree in the recitation rooms, as the steam coils cannot be controlled. Ventilation is entirely dependent on windows, and some care is taken to secure it, as far as can be done. The rooms are not crowded. The yard is muddy; the cellar badly littered.

Orchard Street Primary. — A new brick building, of neat appearance, upon a good-sized lot. It contains four rooms, all in one story — a most praiseworthy feature (fig. 19). The average attendance is over 50 pupils in a room. The dimensions of the rooms are 27 by 34 by $12\frac{1}{2}$. They have the usual arrangement of steam-pipes, running along the base of the side walls ("direct radiation"). As a means of aiding ventilation, in addition to ventilating flues, an open fireplace has been put into each room: it can be stopped up, also, when the janitor chooses. The answer to the question "Is the house sufficiently warmed?" was "Sometimes." The light is insufficient; the windows have a long space to illuminate, and yet they do not come within $3\frac{1}{2}$ feet of the ceiling. One room is too much shaded by

trees. The want of light is most evident in the water closets, which are so placed as not to communicate directly with the outer air. They are 7 feet square internally; this space contains 2 seats and 5 urinals. Some of the water that washes the latter is spilt. In 2 of these closets there was a dank, musty odor. They are exceedingly dark; when the door is closed, all the light comes through two one-foot panes of dusty glass over the door; and the light is still further cut off by the ample roof of the porch.

Orchard Street Grammar. — An old building, not well planned. The light is very deficient in the upper large room; in the lower rooms it is still poorer. The scholars face the light. There is one ventilator in each room, that does not amount to much. The position of the water closets near the foot of the stairs is objectionable, but they are not often offensive. "Colds are too prevalent." There is but one size of desk, corresponding to a range of ages from 11 to 17.

Francis Avenue. — An old wooden building (fig. 20). The plan is poor. The rooms are not well shaped. There are many places where plastering has been restored, with an unsightly effect, and one large piece is now wanting; several windows are broken; the door-sills and steps are wearing out; paint is needed. But the worst feature are the water closets, which are in a shameful condition. There are six in all, each containing two or three seats. Of these, No. 1 has the door off its hinges, and the woodwork is breaking up; No. 2 is offensive, — one basin contains a load which it is unable to get rid of; No. 3, door off hinges, one basin out of order and on the point of running over, — one seat broken off; 4, both basins out of order, and running over; 5, seat defiled, — door off hinges; 6 (a girls' water closet), has a broken bench set up in front of the window as a *curtain.* Nos. 4 and 6 are peculiarly nuisances, because they are in practice directly connected with the school-room; the diagram shows how the water closet is reached by passing through a dark closet, and how a wind in a certain direction will force its way into the school-room from the water closet. The stove in one room needed a new piece of mica, and leaked gas; the health of the teacher was much injured by the

last winter's work. There are no ventilation flues. The cellar was not neat at the time of visit. There were six unvaccinated scholars among 150. The house is not overcrowded.

Russell, at Belair (fig. 21). — This is a wooden building, planned somewhat like the last one, with much regard to economy of space. It stands well, and looks neat; contains 4 rooms in 2 stories. The boys' clothes are hung in the entries; the girls' in closets. The size of the rooms is fairly good: the shape not so good. The cellar is fairly neat. The blinds need repair, the blackboards need renewal, there are no screens to the stoves, one room is not warm enough, the ventilators seem to be useless. The plan shows the arrangement of the two-story privies; which, situated two feet distant from the house, and cleaned out once a year, constitute a great nuisance. They are cut off from the house by a space of the width mentioned, which is furnished with wooden screens. Those for the boys are entered from the entries; the girls pass through the dark closets used for wardrobes, which are also close and ill-smelling. No water is or can be used in the privies.

Pontoosuc. — A new brick house, probably the best in town. Its outside appearance is plain and very neat. In front there are two roomy and well lighted staircases; in the rear, one peculiar one which may serve as a fire-escape. Each room has a fireplace, and the draught is made vigorous by the fact that the flue of the stove runs into the chimney. The base below the blackboard is of neat cream-brick. The space is about 220 cubic feet per scholar (50 to a room). The want of light for several clothes-rooms, which are placed in the middle of the building, is a distinct fault. The floors are of soft pine. The fireplaces are the only ventilators. The privies in use at the time of visit were in a disgraceful state. The house has been used but a short time; but this state of things ought not to have lasted a day.

West Centre. — An old-fashioned one-story "country school" (but not far from the railroad station). It is not especially a bad building for that class of houses, but a new one would be desirable. A class of 12 small children were

excused at $10\frac{3}{4}$ A.M. and at $2\frac{3}{4}$ P.M. The boys' privy is in nearly as bad a state as that of the Pontoosuc. It is also much damaged. There is no lock, and the bad condition of things is ascribed to the loafing factory hands. There is no cover to the vault—or it was not in place; and the interior is very plainly exposed to the view of the children.

Tracy.—A district-school type, in a thinly settled part of the town. There was room enough for the 17 pupils. There was a vestibule and a clothes closet. The privy is somewhat fouled.

Great Barrington.

High School.—Two stories, brick, 180 pupils; recitation rooms crowded and sometimes close, being without ventilation. The air smelt of coal-gas in the upper room. Defective light in the same room, owing to the fact that the window tops are four feet distant from the ceiling. Cellar extremely dark; one side is used at recess, the other is full of all sorts of old lumber. The privy is ten feet from the house, directly opposite some of the windows, and is somewhat neglected.

Primary.—In the same lot with the preceding. Old-fashioned. Cellar badly littered with papers, and very dark. Stoves old, leaky, and nearly worn out. In the lower room the air is said to be often "heavy;" at visit it was very foul. The ceiling is ten feet high; cubic allowance 170 cubic feet. The thermometer stood at 75° throughout the building. The privies were fouled and reeking with urine; there were only 12 seats for 350 pupils in both school-houses.

South Centre.—A wooden house with one room and 27 pupils; comparatively new, and of good size. Temperature 75°. Old desks of two sizes, the smaller ones too small, the larger ones not large enough for boys. The privies occupy two rear closets in the building, and are a nuisance; there is no urinal.

Water Street.—Two rooms, two stories, wooden, recent. In the lower story, with 60 pupils, the air was close and heavy and smelt of gas; the temperature probably near 80°. Cubic space per scholar, only 137 cubic feet. Over the windows of this and the preceding are placed boxes to permit

the windows to be opened without direct draughts. The plan of the house is not bad.

Stockbridge.

High School. — This is partly new, and, in general, is a good building. Its appearance is rather pleasant, and it stands well on a good site. There is a system of ventilation by a number of floor-ducts, which is probably obsolete. Much deficiency in privy accommodations, there being but 7 seats for 175 pupils, all having recess at once. That of the boys is in contact with the house, has no window, is very dark, and was fouled. The vaults were open to view in the rear.

East Street. — A little wooden house of an old fashion, with 15 pupils, by no means crowded; the floor is new, and good new furniture was put in a year ago. The ceiling is arched in a flat curve. A "ventilator," or hole in the wall, opens into the woodshed at the height of twelve feet, and gives the teacher a cold when she sits under it. Outhouse unobjectionable.

Glendale. — Two stories, wooden, not remarkably good. Cellar floor damp. Floors of rooms said to be cold. No screens to stoves. Blackboards poor. Privies accessible from both stories by an arrangement supposed to isolate them; the scholars cross a four-foot screened passage. They are nuisances, and must be so in this situation. In the lower room only 15 scholars remained out of 53, the rest being kept at home for fear of diphtherial contagion. New desks of assorted sizes deserve favorable mention.

Washington.

This is one of the "old hill-towns" of Berkshire; places that were prosperous farming towns a century ago, but have now dwindled, or have even been removed bodily. The township adjoins Pittsfield, but the place is by no means a second Lenox; the population is widely scattered, and is so small that in the five school-houses seen in one day's ride there were only 44 scholars all together. Under these circumstances, the impression produced was one of pleasant surprise at the neatness within and without. The interiors

are finished with painted wood instead of plaster, which has a good effect. The floors are new, the windows whole, the desks mostly of modern make, and some of them quite new — as in the East District, where, however, all were of one size, suited to adults.

The Valley School (at "the City") contains a space of 21 by 24 by 10 = 5,000 cubic feet, which is ample for its 15 pupils. The others were about 17 feet square and 8 feet high. The ceiling ought to be higher than that, for the heat of the stove-pipe is uncomfortably thrown down upon the heads of the scholars by these low ceilings. The stoves are for wood, as usual. They have no screens. The windows in some schools do not open from the top. The air must be rather close in some. The privies are not in a particularly bad state. That of the Congdon school, however, is out of repair, and that house is in need of alteration in some other points. The blackboards are generally poor.

North Centre; Ten pupils, from 4 families.

South Centre. — Very comfortable and good; wooden finish, neatly painted, new floor, good new desks, too hot room, windows do not let down at top, no cellar, but not damp.

Valley. — Thirteen present, larger than the preceding, wood finish, new desks, not damp.

East District. — Four present, on top of a high hill.

Congdon. — Six present; older than the other buildings, but not specially bad, though it needs a new stove, and new underpinning, and repairs on the outhouse.

Dalton.

This town lies on the Boston and Albany Railroad, quite near Pittsfield; is a prosperous place, and has eight school buildings, lying wide apart. Three have one room apiece, four have two rooms, and one is in the town hall. They generally look pretty on the outside, and are in a tolerably good state of repair, but are not quite satisfactory in their internal arrangements. The plans are typically alike in one point; that is, in most of them the privies are under the very same roof with the house, so that the effluvia pass directly into a close passage or closet, and thence into the schoolroom. The science of school architecture has taken its first

step beyond the primitive arrangement of separate outhouses, and the result of this first step has not been good. The arrangement spoken of may be compared with that seen in the Francis Street school in Pittsfield.

Another plan, the results of which, under constant care, are satisfactory, is that which is found in the Grammar-High School, where the girls' privy is within four feet of the house, but is disconnected by a latticed passage. The authorities here have not considered their duty finished when the building was completed, as is generally the case, but have continued to give constant care to the arrangements for health. The vaults are of brick, are very frequently emptied, and dry earth is constantly sprinkled over; a man is paid to remove all once a month. The boys' place is at a distance. This school is four years old; it was built near some wet land, and has just been raised three feet to relieve the dampness. It is one story high. The schoolrooms, like most in the town, seemed close.

There were fires in the stoves in all the houses. The plan of ventilation is to insert a little register near the ceiling, just where the pipe enters the chimney; it does not prove a nuisance after the fires are started. The regular stove is of cast iron, for burning wood, and has no screens. The desks in some cases are of new patterns, but usually they are of old. Sometimes they are graded in sizes, an arrangement much more necessary in the country than in the city schools. The following detail is given:

High and Grammar. — Well cared for.

North Street. — Poor desks; scholars face two windows almost necessarily; the boys' privy is fouled.

East Street. — Desks not suitable for little pupils. Boys' place fouled.

Central Primary. — One room has direct communication with the cellar, and smells close and musty; there is complaint of dampness from the cellar in the same room. The girls' places are very offensive, that for the boys still worse.

Town House Room. — A single spacious room, agreeable and doubtless wholesome. The privy is 50 feet distant, has two compartments, is locked, is in good order, and has sliding boxes for removal; it stands very near the one last mentioned.

Craneville. — Offensive privies.

Bartonville. — The same condition very often.

South Street. — Cellar said to be damp. Blinds on the inside. Ventilation "by loose windows." Outhouse 25 feet distant, not in a bad state.

Cheshire.

Cheshire lies to the north of Pittsfield, and was taken as another specimen of a rural town.

Academy, or Centre School. — The building is greatly neglected. Air enters through holes knocked in the plastering by rough usage; there is scribbling on the walls, perhaps to be ascribed to those who attend the public meetings in the third story. The cellar was not neat. The plan is inconvenient, the cloak-rooms small and dark, the stairs built so that the windows cannot be cleaned, ventilation badly provided for. Cubic space in four rooms, 168, 189, 217, 308 per head. The boys' privy is 100 feet distant, and is very much defiled; a door is broken, and it has no locks. The trouble is said to come from outsiders.

Cheshire Harbor School. — A neat little house with from 25 to 37 pupils. It possessed the raggedest dictionary seen during the trip. The screen for the stove, the stove and flue, the plastering, the blinds, were faulty. The house stands prettily at the edge of a thick wood which screens the outhouse; it is a pity to have to add that the latter, as is usual in country places, has two compartments with holes cut through the partition.

West School. — A little old building, in a hilly remote part of the town; a thorough type of the old "district school-house." The house shows its age. The roof is hogged. The outhouse is full of cracks, exposing the occupants to the weather; it stands six feet from the house. The blinds need repair, the plastering is broken, the ceiling threatens to fall, some window panes are broken, the outer door and the closet door are broken, the stove is cracked and has no screen, the metal plate under the stove is worn out, and (perhaps worse than most other faults) the blackboards are very poor. These things are set down as they are found, but there is a bright side; for the district has

found means to furnish new desks, and the school is a good deal better than the school-house. In this little shanty, with its 25 scholars crowded into a space of only 19 feet square and 8 feet high, there were some pupils of nearly adult age, and *algebra* was well taught.

Adams.

Academy. — Three-story, brick; old, four-square plan (compare fig. 2). The ventilation is bad. The cellar air is close; its walls were never whitened; the children use the place to romp in. The entire house was also close when visited; I saw it when first opened in the morning. It having been found impossible to warm certain parts of the house by the means formerly in use, the plan was adopted of cutting a small hatchway over each of the furnaces, through the floor of the school-rooms above, so as to admit a supply of warmed cellar air. This was the janitor's plan, and has proved successful as regards warming. Wooden flues are also arranged so as to suck down air from the school-rooms in order to warm and re-distribute it to the rooms. The privies are at a good distance, perhaps 100 feet. The receptacle is not a vault, but a slab pavement *on the level of the floor*, which is cleaned out once a year. Fouled, and evidently much neglected.

Commercial Street. — Brick, two stories, eight rooms; plan, four-square. There are 400 pupils; one room was over-filled, with 82 pupils present. The latrines in the cellar are good; more frequent cleansing would be desirable. The ventilation is partly provided for by open fireplaces. The house is new and good.

Renfrew. — Two stories, eight rooms, brick. Outward appearance much like that of the preceding. Peculiar arrangement of stairs, two flights, entirely separate, clear from the walls and from the doors, in the middle of the wide corridor. Most of the rooms have two doors, and by keeping them open may obtain tolerable air. The system of heating, however, is very questionable. The cellar is dark, and in it is seen a maze of wooden flues, having a double purpose: to suck the air from the school-rooms, and to draw it from out-doors, both for the supply of the furnace. The former

object was not effected at the time of the visit, for the air was coming up in a feeble stream into the rooms by the first named set of flues; it smelt musty and dusty. As to the latter set of flues, opening to the out-door air, their inlets, consisting of two windows of 24 by 30 inches, and one of 12 by 20, were tightly closed. The same flues were littered inside with rubbish, some of which had fallen from the school-rooms; and one was used to store paints, and another, for carpenter's tools. The date was October 22. The privies seemed much neglected; the windows were boarded up for want of shutters. The receptacle was a slab pavement a foot below the floor, accessible from behind, such as might have been made very neat if regularly attended to; it was offensive.

North Adams.

The buildings are mostly rather large for the size of the place, but that corresponds with the compactness of the population. There is evidence of progress, in the presence of excellent new latrines and urinals in three of five places visited. The newly altered building (Union) is commendable, except as to ventilation, which is very poor in the rest of the schools also. The tendency is to increase the size of the classes to sixty or thereabouts; this fault should be relieved by new buildings, as it has already been in the Academy. None of the buildings are quite of the first class; three are good, two are very poor, and doubtless will soon be demolished along with their attendant nuisances.

Drury Academy. — This very large school (it contains 1,000 pupils) is interesting, as showing a modification of the type of a four-square house, which is illustrated so often in Boston. It is modified simply by the addition of a three-story wing. The building is not likely to be copied as a model. The site is a hill, and gives good light. An iron fire-escape, covering one entire end of the building, gives it the appearance of a factory. Like most of the schools in this town, it is heated by direct radiation. The ventilators act very irregularly. There are window-boards. The blackboards are *not* placed on the sides by the windows, a very unusual circumstance in schools; the same is the case in the

Union. The water closets and urinals are in the basement, and were devoid of offensive odor. The janitor washes the floor of the latter apartment five times a day; it is built in the simplest form, a slate foot-rest, a deep gutter in the floor, and uprights of slate. The latrines are Mott's. There are eighteen seats, and the children are allowed to go out of recess. The general impression is good, but the ventilation is not to be depended on.

Union. — A woollen mill converted into a school, giving four rooms on a floor, occupying the corners, with much intermediate space for small rooms and entries. The windows have not been changed, and it is hard to open them. The lot is large, and it is believed that there will always be sufficient open space all around the house. Each room has a recitation room, a cloak room, and a wash-stand with faucet. The general appearance is neat and good, the shape of the rooms is correct, and the light abundant. Ventilation, however, is very poor. The recitation rooms are adapted to very small classes, which, indeed, corresponds to those actually using them. The cellar is large, airy and neat, containing nine seats (latrines).

Chestnut Street. — The house is 40 or 50 years old, and is in a bad state. There is no cellar. The walls at one end are bulged out, and the line of the cornice at that end is sunk. The plaster is badly patched; there is a general look of decrepitude. The Superintendent observed that the effect of the frost upon the walls was greater this spring than previously. The house was condemned by State Inspector Lynde last season. There were 92 scholars. In the recitation room (12 by 19 by 10) there were 24 children, giving an allowance of 95 cubic feet of air per head; and in that room there was but one window, so that it is necessarily dark and close. The plan (fig. 22) shows a 2-story building (L) very near the window in question; if opened, that window commands a prospect of about a square rod, bounded by the L, a shed, the porch and a muck yard. The latter, and the barn, are richly filled with "the farmer's savings bank." The privy of the school, distant 10 feet, is in a fearful condition. The other privies are 4 feet distant. An effort to

have a new house was making; it is to be hoped that it will succeed.

Wesleyan Hill. — This little house is at least 30 years old. The pupils are of the youngest grade, and the largest number present this year has been 58, with one teacher. This allows 95 cubic feet per head, which is a marked case of overcrowding. There is no cellar. In winter it is very cold. There are no shades for the windows. The privy door is within 8 inches of one of the windows of the school-room, and the place is old, out of repair, and a bad nuisance. A new building is needed.

Vesey Street. — A four-roomed building, with large classes — the two lowest, 60 each. The house is respectable in a general way. There is one recitation-room measuring 12 by 14 feet, which receives a class of 13, and is poorly lighted. The stairs are wide; cellar neat; heating by direct radiation. Latrines (9) in cellar. Urinals not properly attended to.

Williamstown.

The principal school building contains a high and a grammar school in the two upper rooms, with an intermediate and a primary in the two lower ones. In these rooms the number of the pupils is 28, 30, 50 and 81, respectively, giving a cubic space per head of 364 in the High school and 126 in the primary. If this important building be compared with those of other towns visited in this county, the comparison will not be greatly in favor of Williamstown. One recitation-room measures 11 by 14. There is no fit place for the apparatus. The steps to the front door are of wood, which is in keeping with the generally poor look of the house. There is no wash-place, and the water-pipes are not brought up-stairs; this may be mentioned in connection with the complaint that the house is cold in winter. There is little ventilation, and the stoves are not screened. In the High-school room the pupils face the light. The blackboards are poor. The privies are not well built. They stand 40 feet in the rear, but the paths to them are two alleys between very high fences, which conduct the smell directly to the house. The places were defiled; the pits neglected.

Another school-house was seen near the station; a small

one-roomed building, containing a ragged set of children. The privy was defiled, the steps broken; the general appearance not attractive.

Shelburne Falls.

The village school is a 2-story wooden building in good condition. An L has been added to contain clothes rooms, and the space is sufficient. The cubic space per head is 220 cubic feet and upwards. Each room has three sizes of desks, for pupils ranging within 3 or 4 years of the same age; a desirable plan, but one that is very rarely seen carried out. Blinds, and screens to the stoves, are needed.

Buckland.

Grammar School.— A 2-story brick house with 4 rooms; there are two staircases placed between the rooms. A partition in the middle, between the staircases, completely cuts off one-half of the house from the other. Cubic space per head, from 178 to 223. The windows are not sufficient, being too far from the ceiling; but the site is so high and exposed that no deficiency of light is noticed. The master remarked that the pupils did better work in their writing classes when furnished with tinted paper. The house is not attractive in itself or surroundings. Neglect appears in the broken steps, windows, plastering and hooks, the cracked stoves, and the very poor blackboards. The state of the privies is very bad, the floors fouled and the pits overflowing in sight of the scholars.

Intermediate School. — A small country school of one-story and one room, of average quality, and sufficient size for the present population.

NOTES UPON THE FIGURES.

1, 2. *Dwight School.* — Illustrating one of the most compact plans, typical of a large number built from ten to thirty years ago. Rooms nearly square; light from two sides of each room, without regard to choice between left and right hand. In the plan of the basement, the distance to the latrines has been shortened for the convenience of the engraver.

3. *Andrew.* — A recent modification of the above plan, including the insertion of two school-rooms midway, with unilateral light. (Page 27.)

4. *Dorchester-Everett.* — A further modification. The shape of the house is nearly as in figure 1, 2; but the principle of unilateral lighting is made universal. (Page 19.)

5, 6. *Prince.* — Fully described elsewhere. (Page 15.)

7. *Girls' High.* — Introduced to illustrate the undesirable effects of too compact a plan, such as deficient light in the interior, excessive size of rooms, sluggish circulation of air through corridors and rooms. It should be stated that, while the reporter is acquainted with this interior of building, no special visit was made for the purposes of this report. The head-master states that much has been done to improve ventilation by the use of eureka valves.

8. *Wells.* — Light excluded by houses on one side and half of another, and largely by trees on the other two. (Pages 11, 23.)

9. *Grant Primary.* — Old style. Stairs objectionable for position and build. No clothes-closets. Rooms ill shaped. Yard very small. (Page 28.) (A, girls' water closet; B, C, boys' urinal and privy.)

10–13. *Latin-High.* — The class-rooms are nearly alike. The floor-plan shows one room with portion of corridor, making the entire width of the building. The windows are represented as occupying as much space as was possible consistently with the strength of the walls. The size and position of the transoms, and the relative size of the corridors, are shown in 9 and 10. In 10 is seen the arrangement of cupboards near the windows, used to keep the boys' over-clothing. (Pages 9, 17.)

14. *Benjamin Pope Primary.* — The oblong shape of the rooms as compared with those in fig. 2 deserves notice; it is an improvement which characterizes the newer buildings. The size is more liberal than was the case in older primary schools. The circulation and light in the hall is good. (Page 20.)

15. *Tyler Street Primary.* — Old-fashioned plan. Rooms ill-shaped, stairs not well placed, space for yard small, light imperfect. (Page 31.)

The above schools are in Boston.

16. *High School, Springfield.* — Described elsewhere. (Page 58.)

17. *Centre, Pittsfield.* — Excessive size of main room; undesirable position, and crowding of water closet and clothes closets. (S, stairs.) Undesirable surroundings. (Page 63.)

18. Enlargement of lower right-hand corner of above plan, second story, showing dark, close situation of water closet.

19. *Orchard Street.* — The chief point shown is the (undesirable) central position of water closet, with poor light and want of circulation of air. (Page 64.)

20. *Francis Avenue.* — Rooms badly shaped. Only one stair. Water closet badly placed. (Page 65.)

21. *Russell.* — Similar faults. (Page 66.)

22. *Chestnut Street, North Adams.* — Recitation room in very bad place. Surroundings bad. (Page 74.)

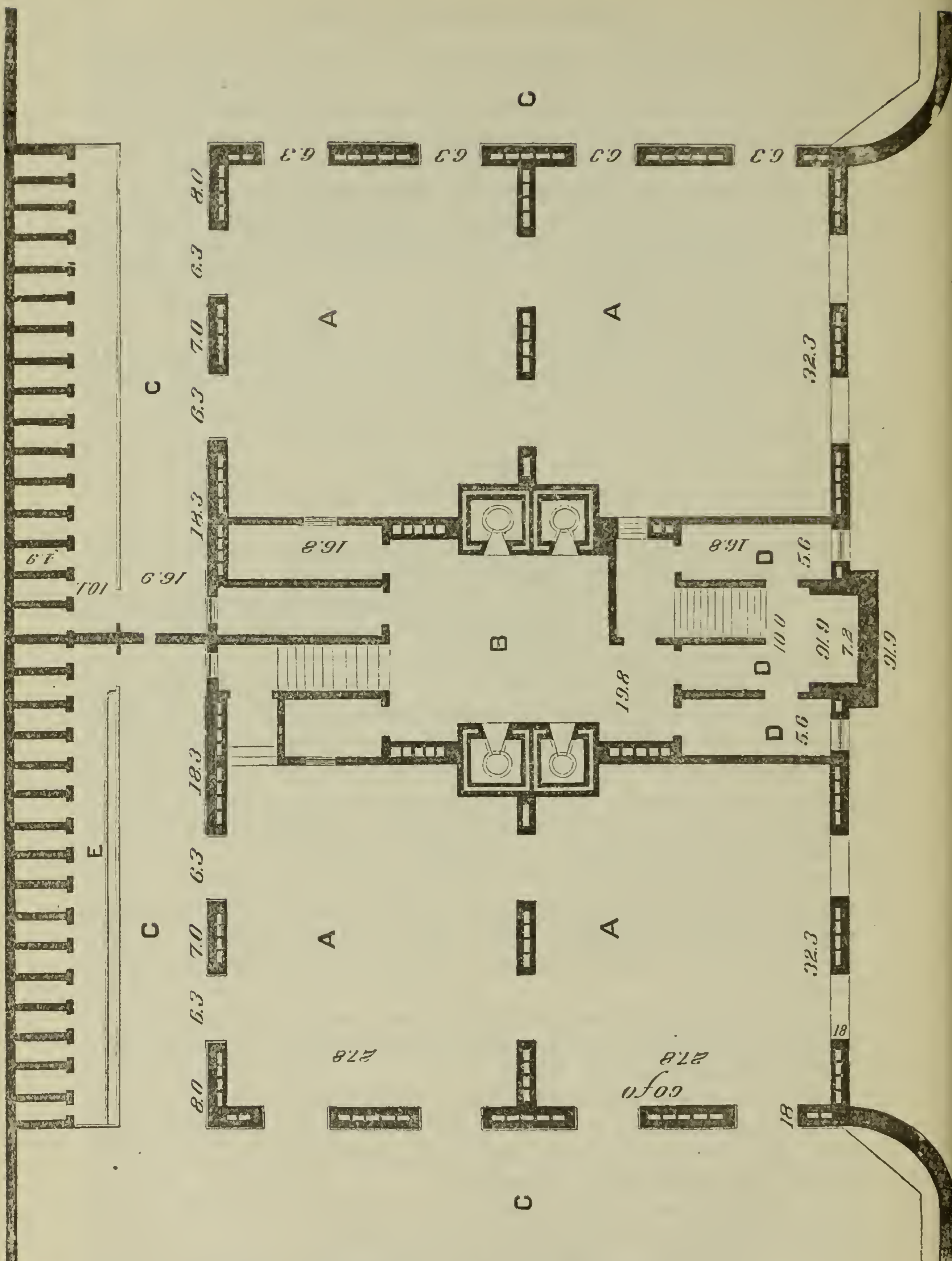


Fig. 1. BASEMENT.—DWIGHT SCHOOL-HOUSE.

A. Play Rooms. B. Furnace Room. C. Paved Yard. D. Front Entrance. E. Privies.

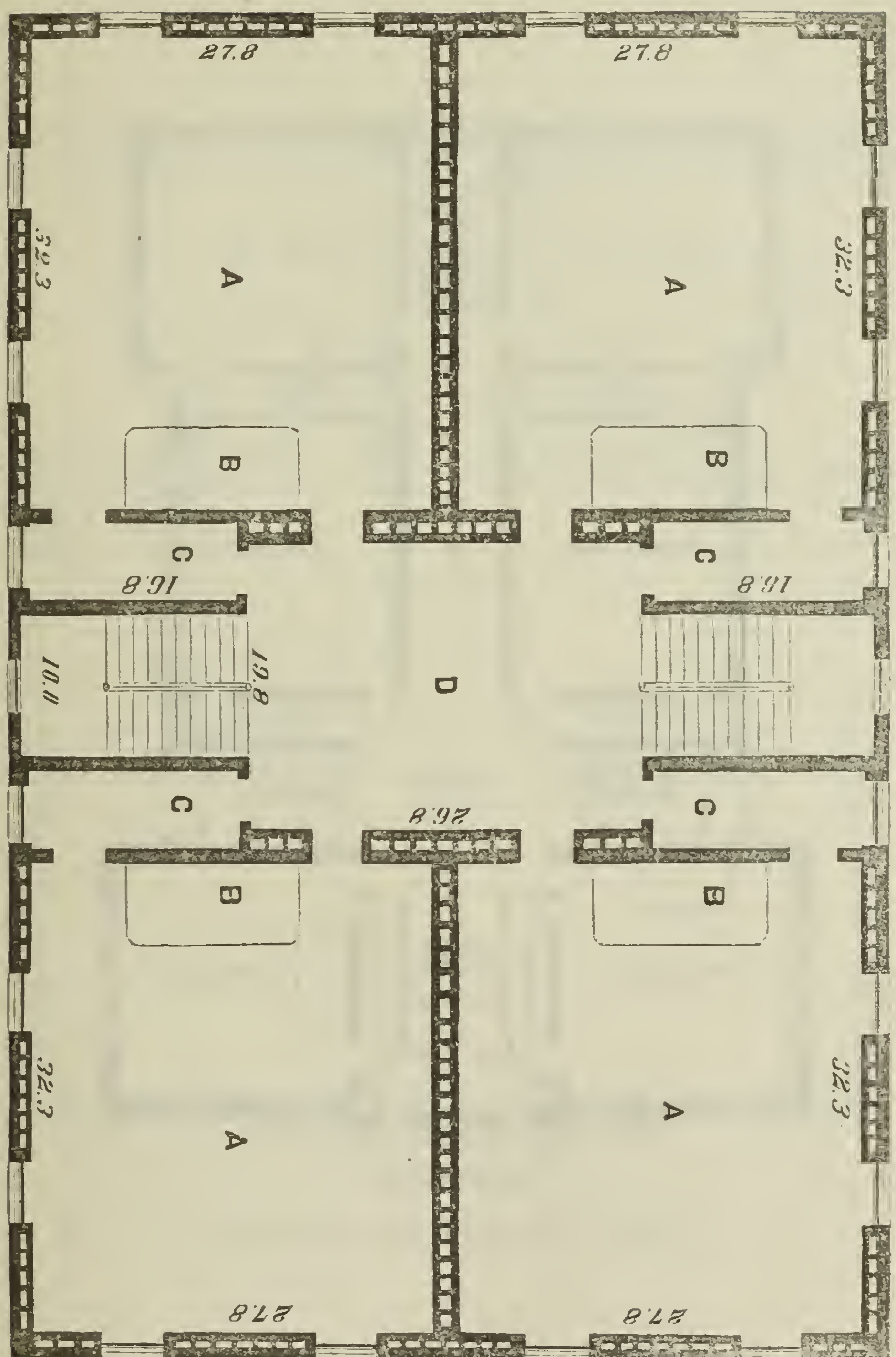
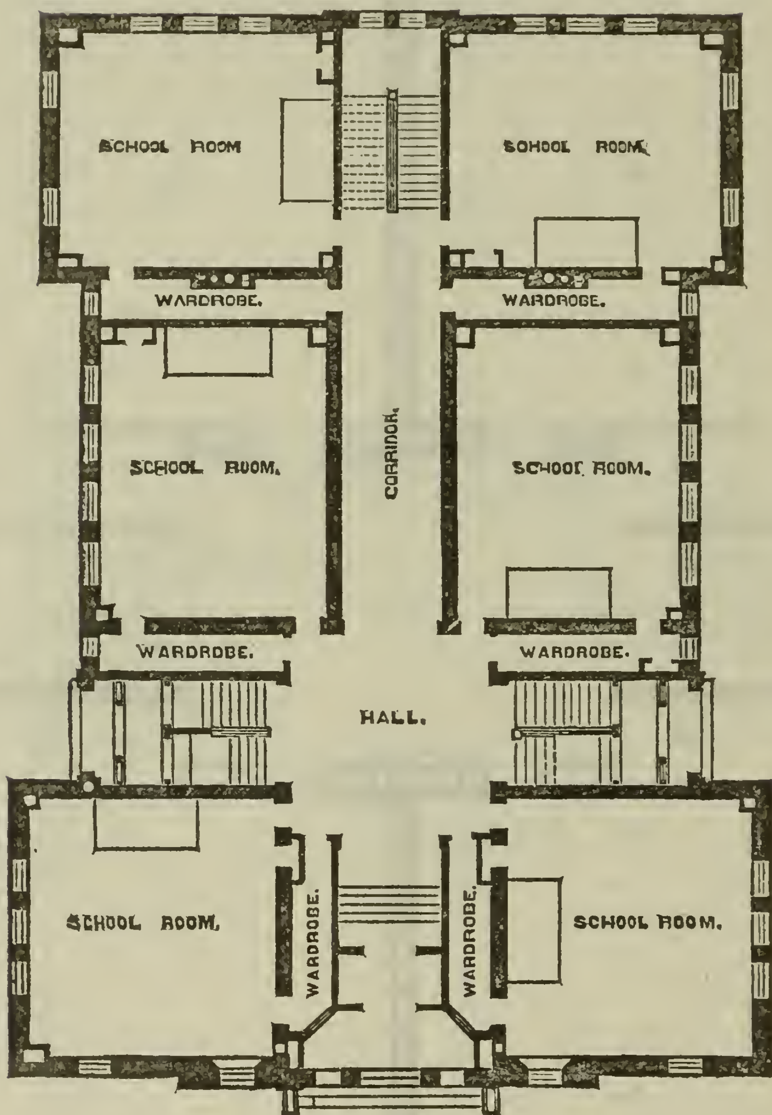


Fig. 2. FIRST FLOOR.—DWIGHT SCHOOL-HOUSE.

A. School Room. C. Clothes Closet.
B. Teachers' Platform. D. Corridor.



FIRST FLOOR.

Fig. 3. ANDREW SCHOOL-HOUSE.

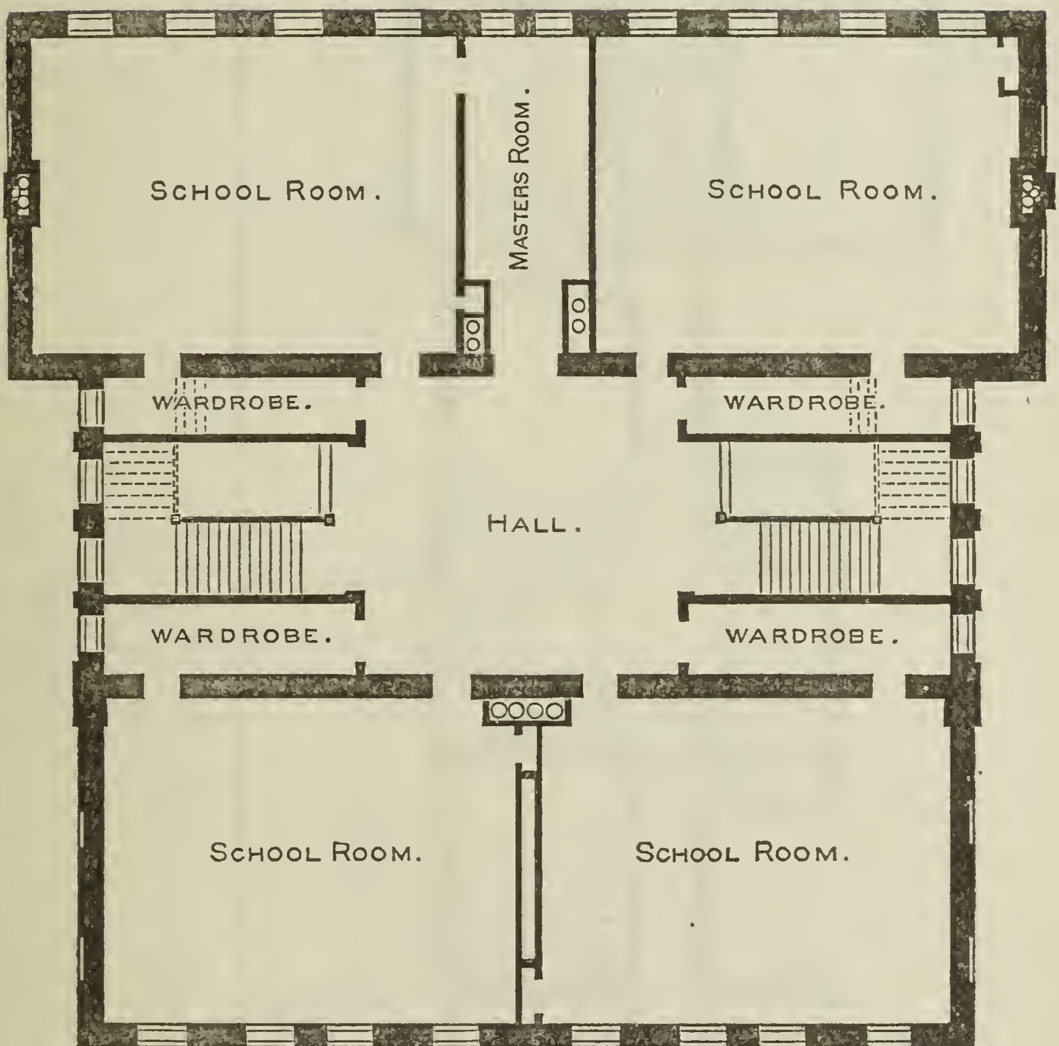
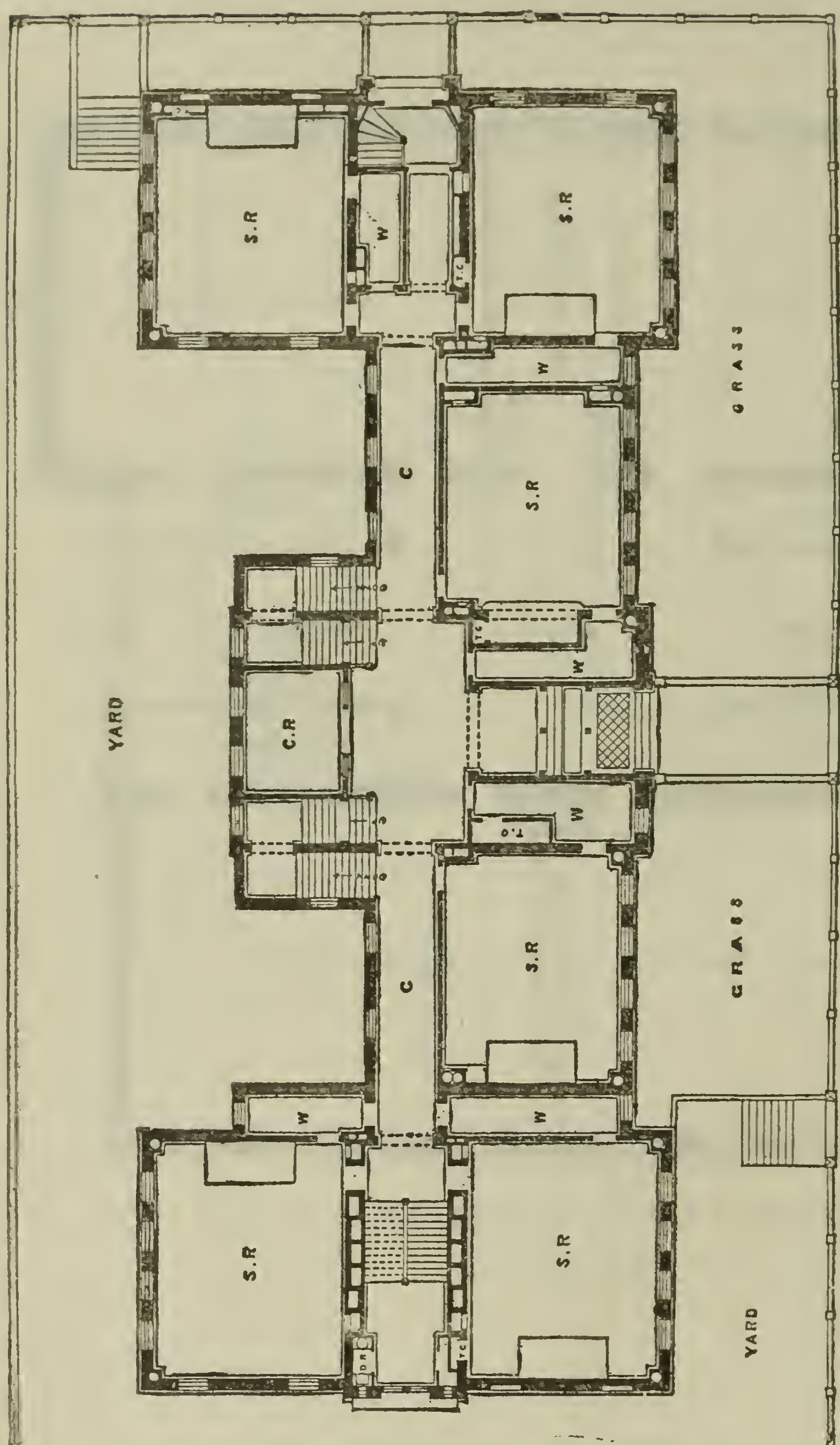


Fig. 4. DORCHESTER-EVERETT SCHOOL-HOUSE, BOSTON. (See p. 19.)

SECOND FLOOR.

Fig. 5. PRINCE SCHOOL-HOUSE. (See pages 15 and 16.)



FIRST FLOOR PLAN.

S. R. School Room.
W. Wardrobe.
C. R. Consultation Room,
C. Corridor.
T. C. Teachers' Closet.
D. R. Dressing Room.

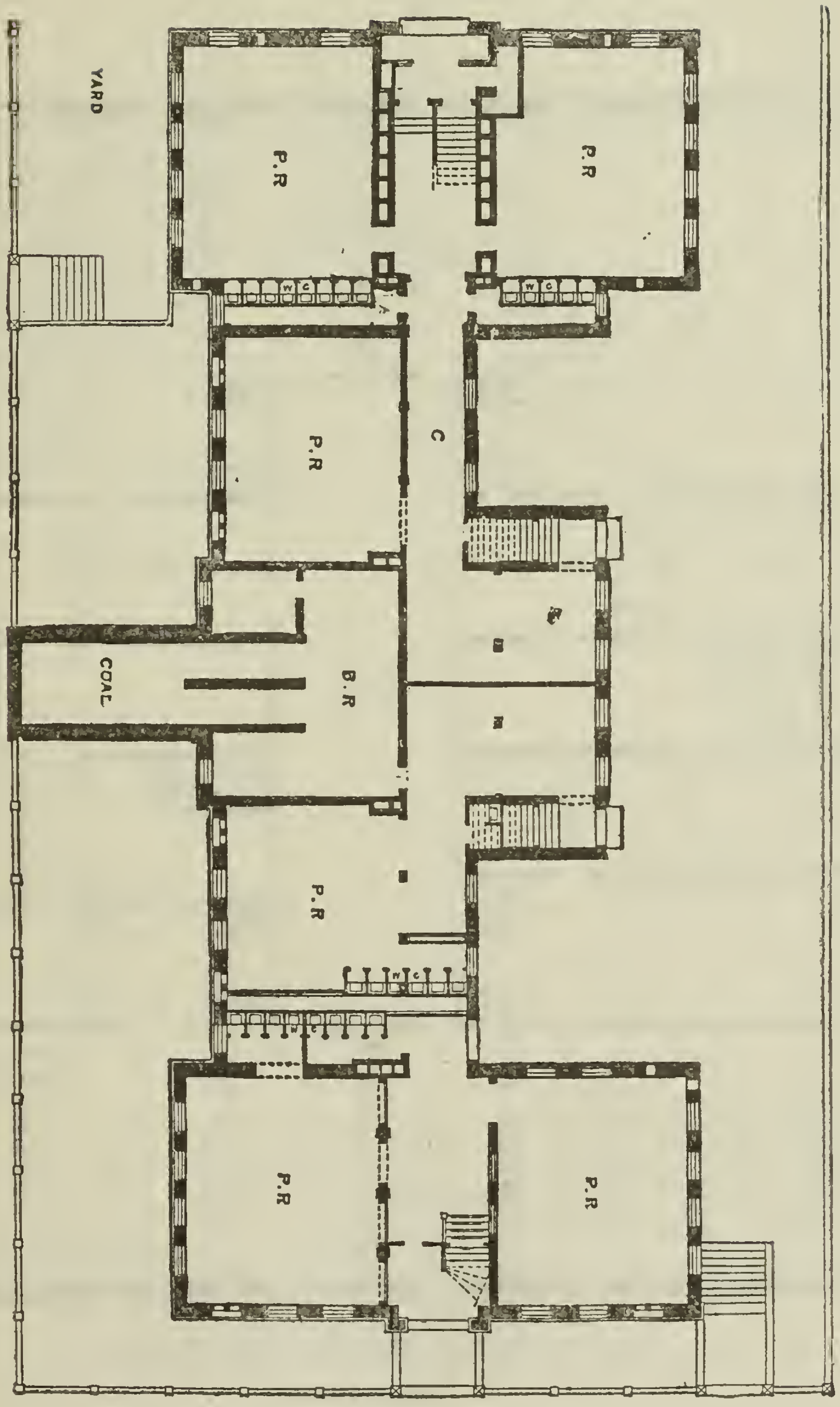


Fig. 6. PRINCE SCHOOL-HOUSE.

BASEMENT PLAN.

P. R. Play Room.
B. R. Boiler Room.
C. Corridor.
W. C. Water Closets.

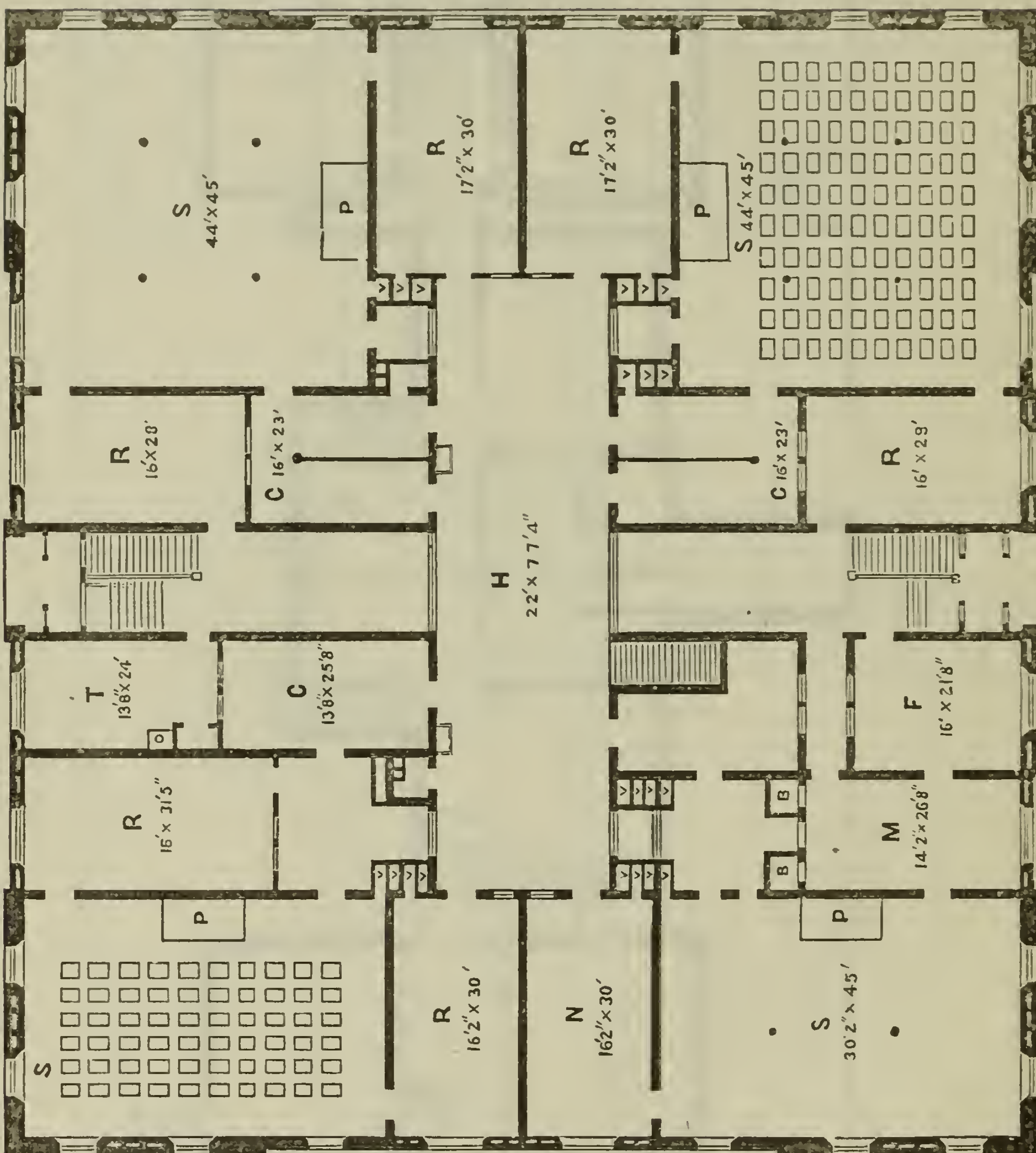


Fig. 7. GIRLS' HIGH-SCHOOL HOUSE.

FIRST STORY.

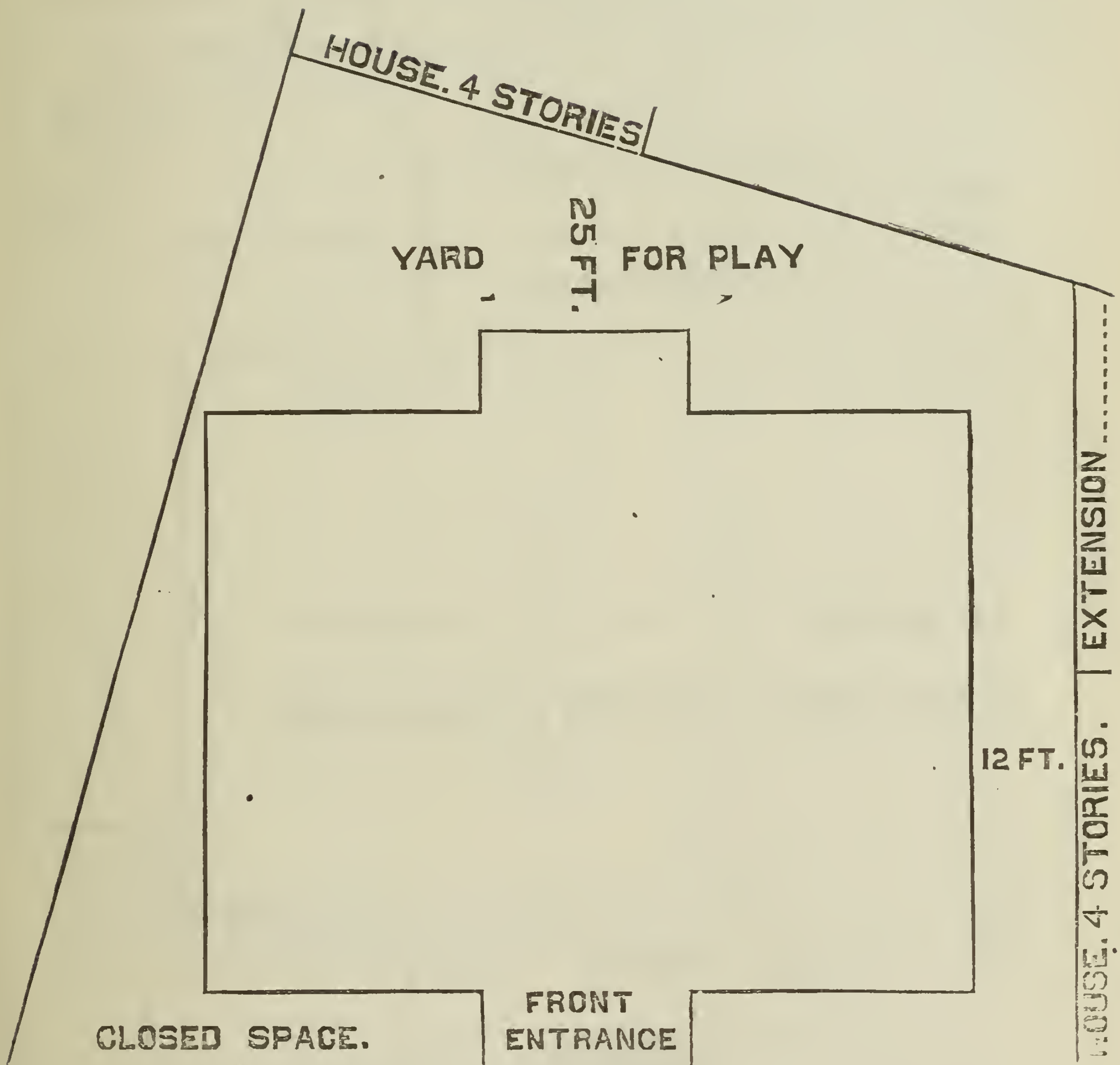


Fig. 8. WELLS SCHOOL.

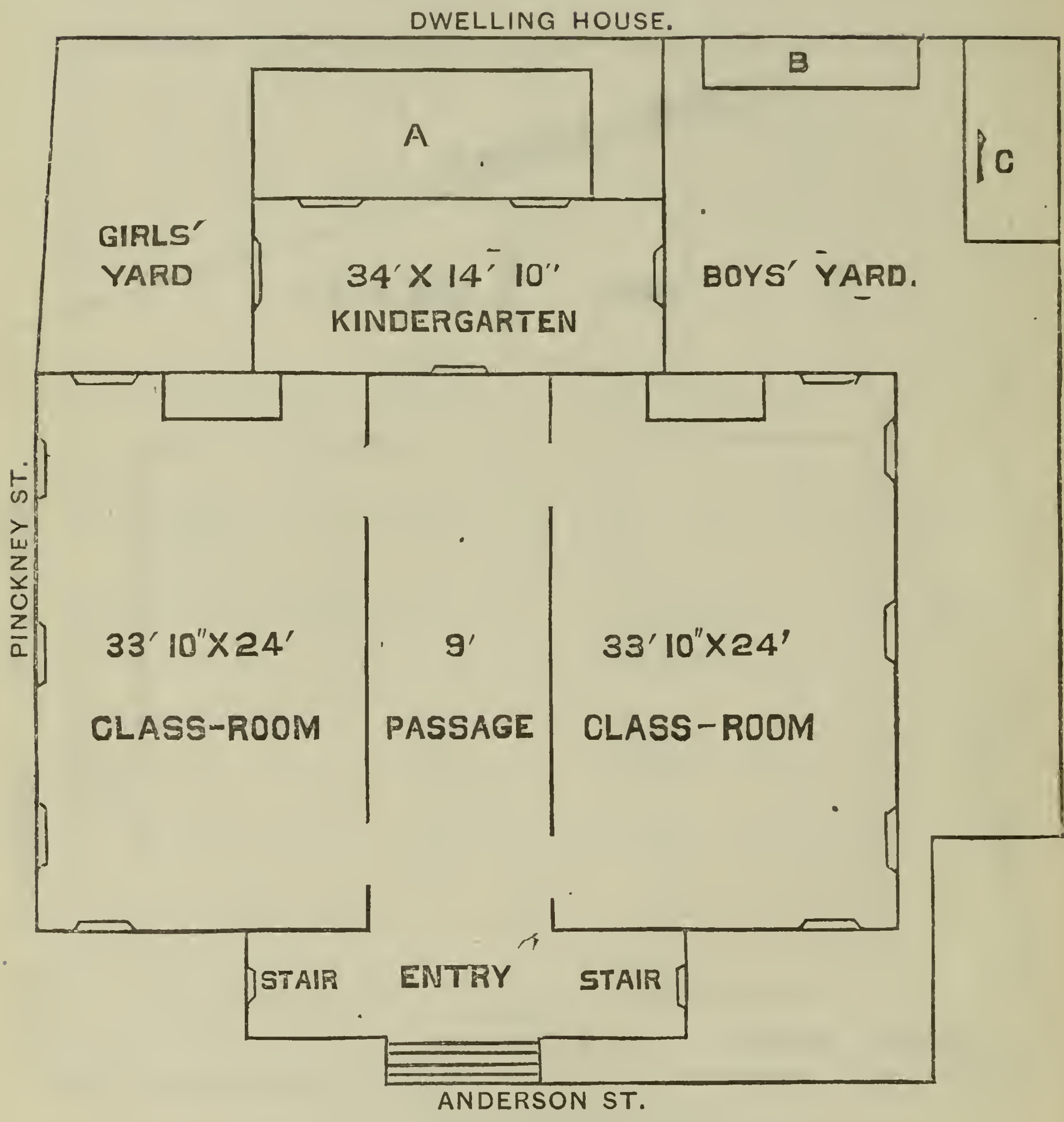
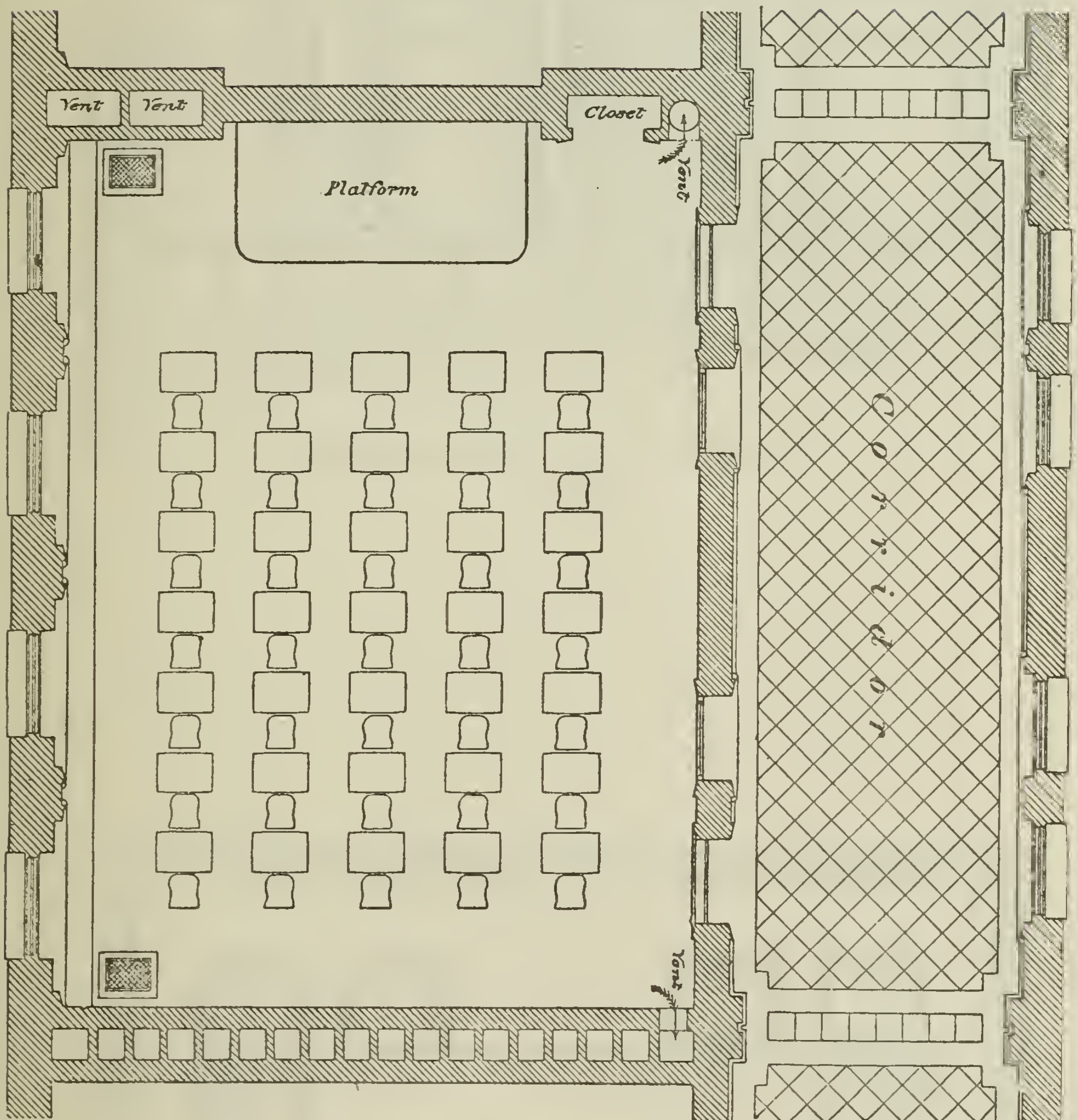
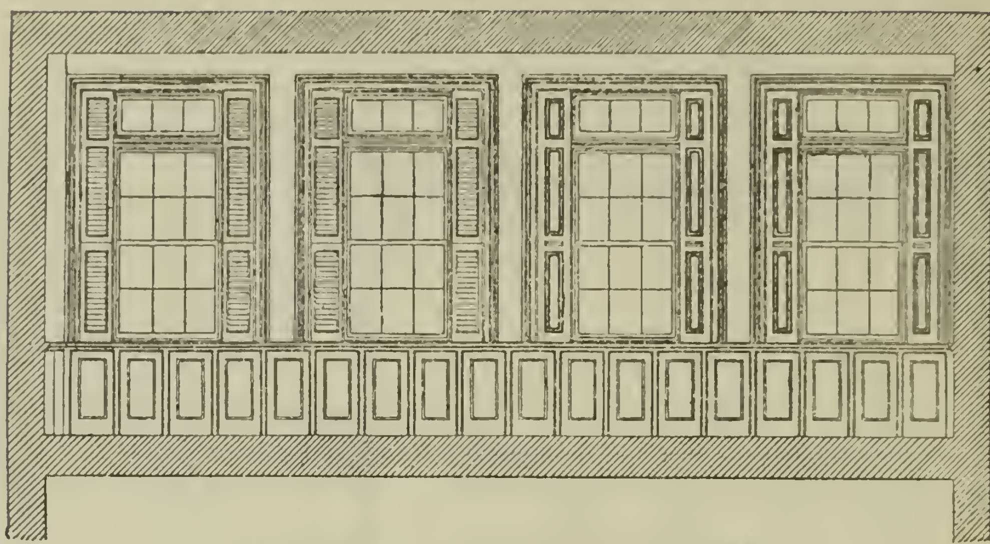


Fig. 9. GRANT PRIMARY, PHILLIPS STREET.



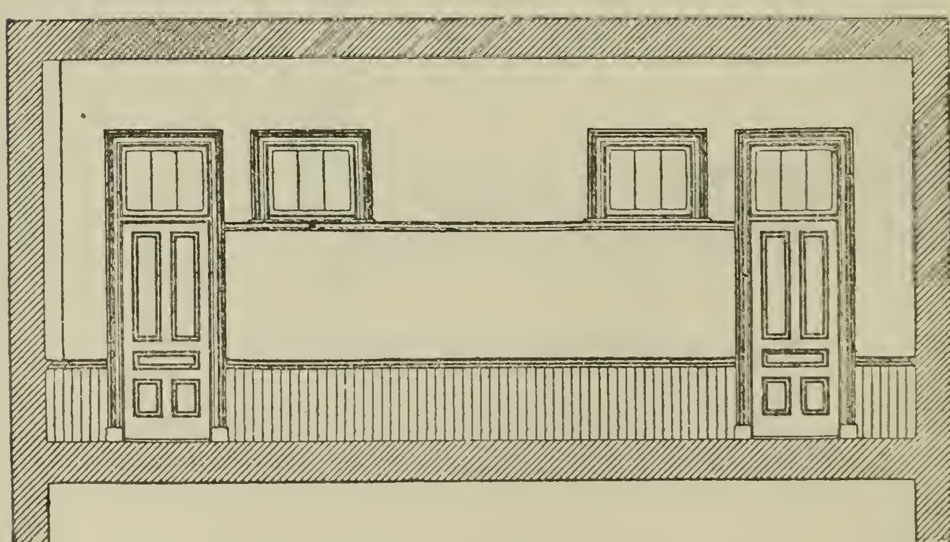
Plan of School Room and Corridor

Fig. 10. LATIN-HIGH SCHOOL-HOUSE. (See pages 17 and 18.)



WINDOW SIDE OF SCHOOL ROOM.

Fig. 11.



Corridor side of School Room

Fig. 12.

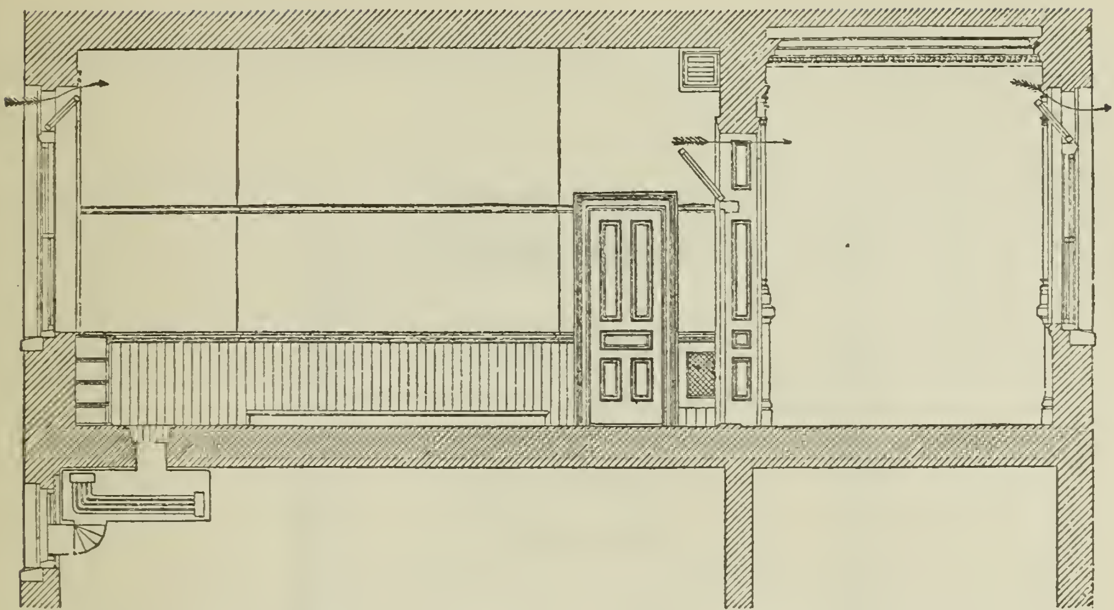


Fig. 13. TRANSVERSE SECTION OF SCHOOL-ROOM AND CORRIDOR.

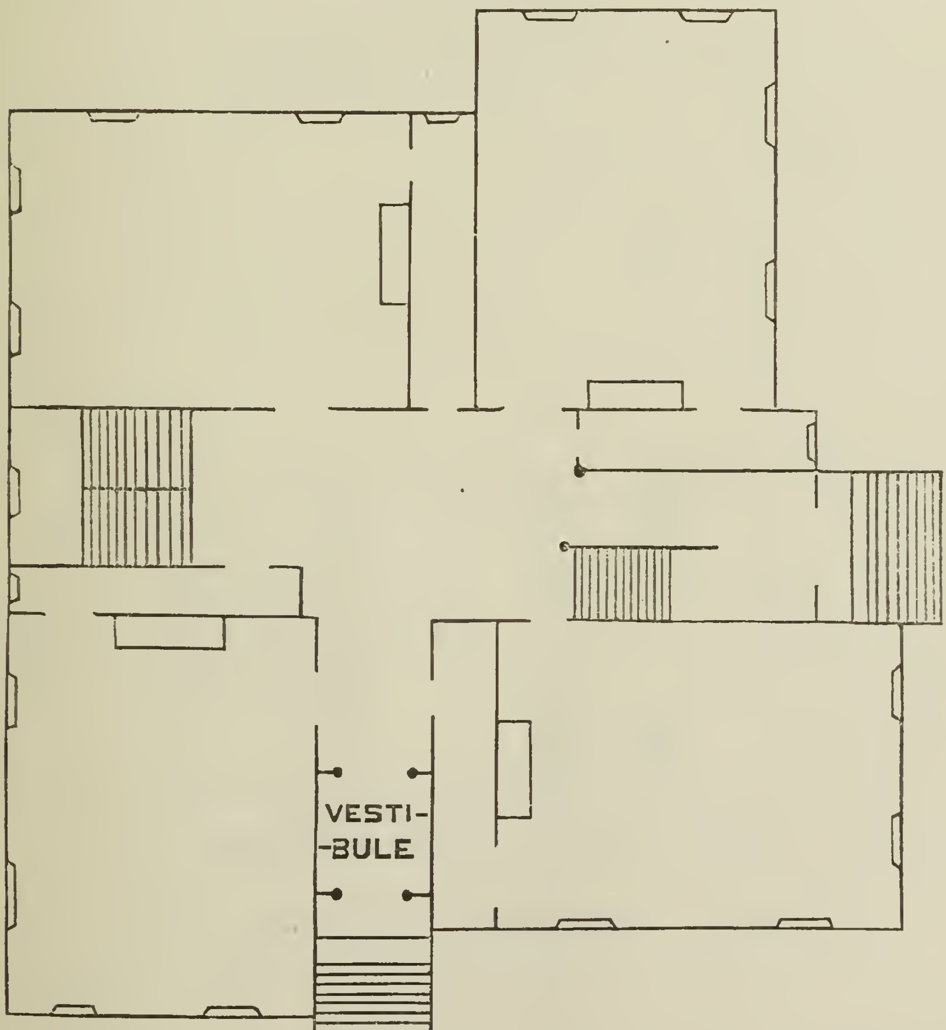
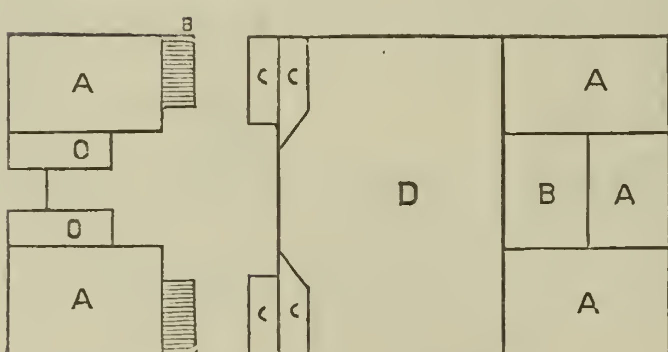


Fig. 14. BENJAMIN POPE PRIMARY, O STREET, SOUTH BOSTON. (See page 20.)

Fig. 15. TYLER STREET PRIMARY.



A Recitation Rooms.
B Stairs.
C Cloak Rooms.
D Study Room.
O Offices.

Fig. 16. HIGH SCHOOL, SPRINGFIELD.

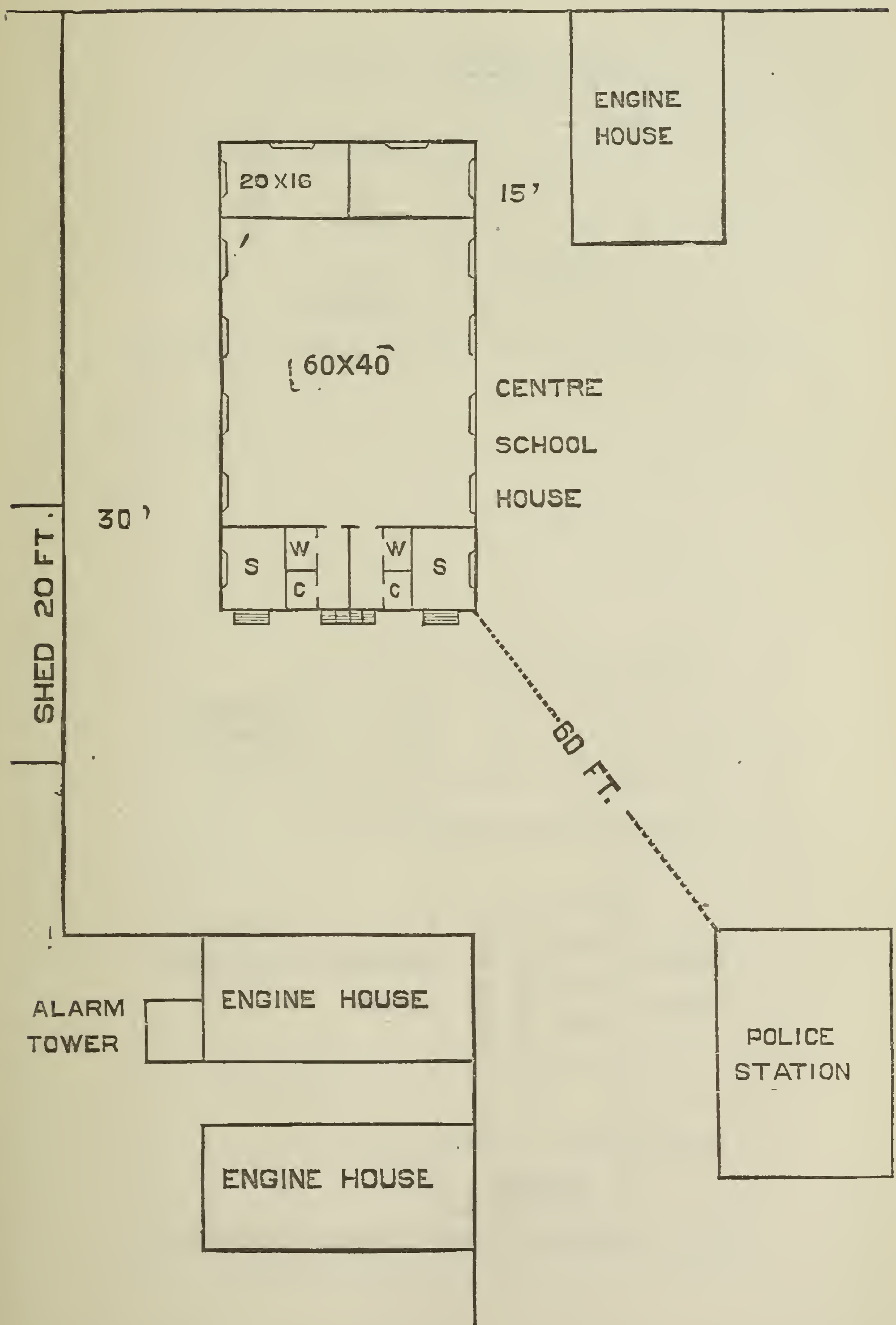


Fig. 17. CENTRE SCHOOL-HOUSE AND SURROUNDINGS, PITTSFIELD.

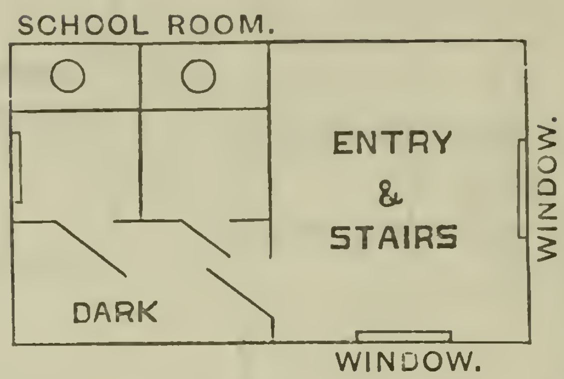


Fig. 18. WATER CLOSET, CENTRE SCHOOL, PITTSFIELD.

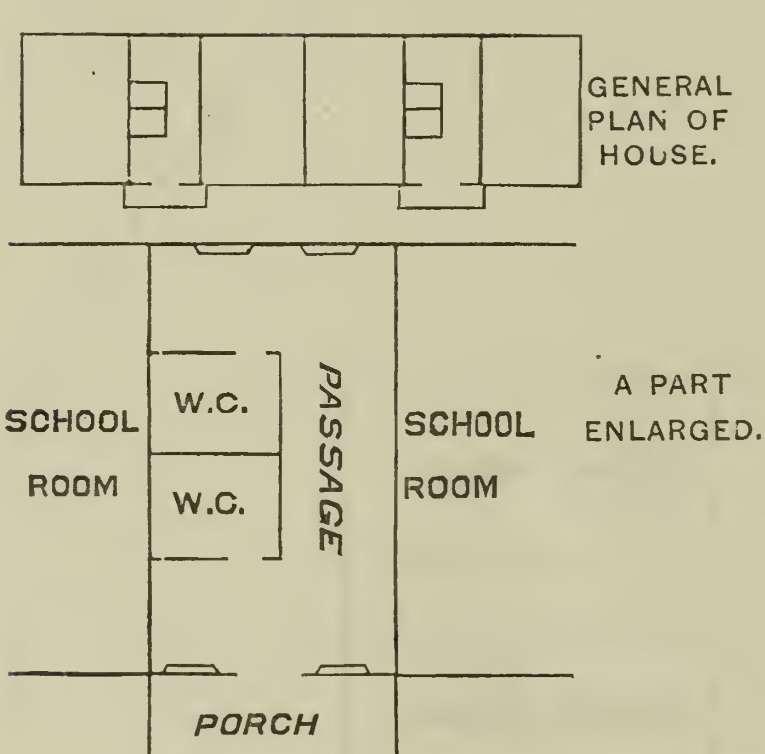
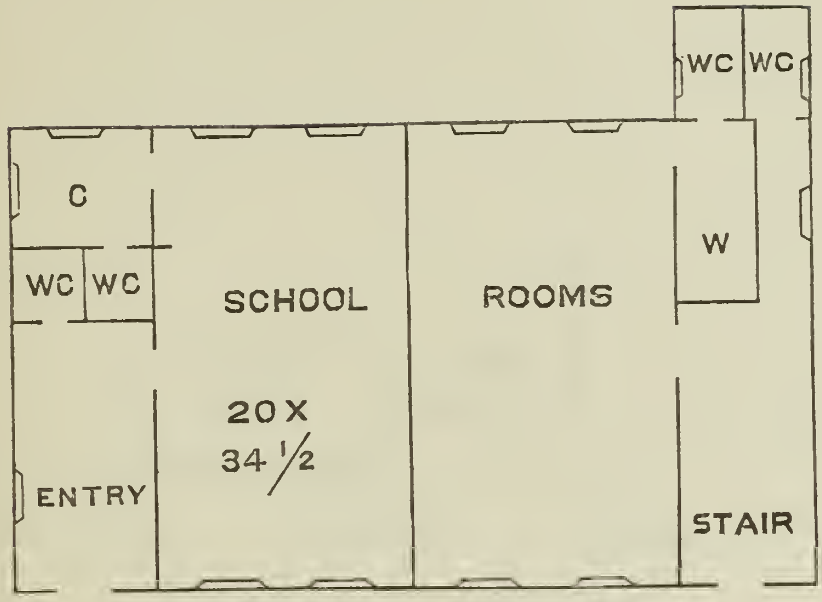


Fig. 19. ORCHARD STREET PRIMARY, PITTSFIELD.



C Clothes Room. W Dark Closet.

Fig. 20. FRANCIS AVENUE SCHOOL, PITTSFIELD.

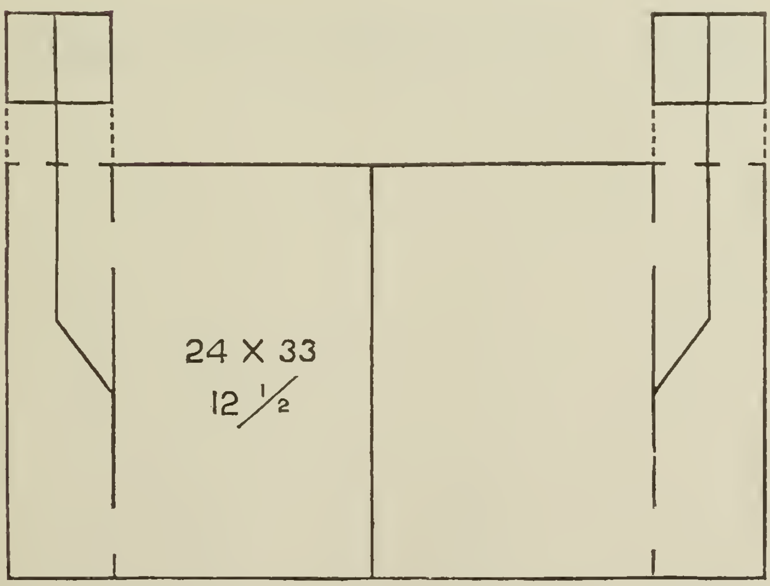


Fig. 21. RUSSELL SCHOOL, BELAIR, NEAR PITTSFIELD.

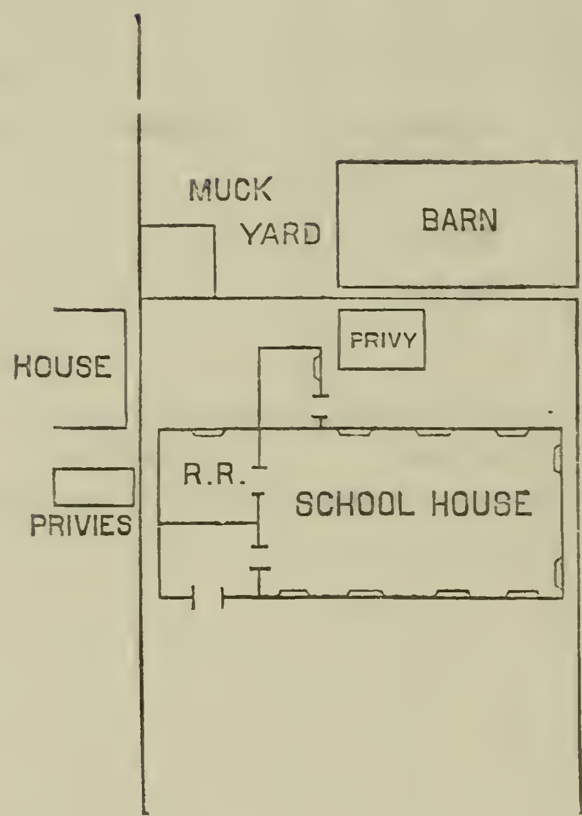


Fig. 22. CHESTNUT STREET, NORTH ADAMS.

SECOND ANNUAL REPORT

OF THE

WORK DONE IN COMPLIANCE WITH THE STATUTES RELATIVE TO THE

ADULTERATION OF FOOD AND DRUGS.

INSPECTION OF FOOD AND DRUGS.

To the Hon. CHARLES F. DONNELLY,
Chairman of the State Board of Health, Lunacy and Charity.

SIR: — I have the honor to present herewith a report of the operations of the Health Department for the year 1884, performed in compliance with the statutes relative to the inspection of Food and Drugs.

The reports of the analysts embrace the work done by them during the entire year under the appropriation of 1883, and also under that of 1884, which went into effect in June of the latter year, by which increased facilities were offered for a greater amount of work and better methods of operation than had been possible during the previous year.

A brief summary of the work done for the year ending Sept. 30, 1884 has already been given in the Sixth Annual Report of the Board (pages l–liii). The present report embraces a more detailed account of the work done for the year 1884.

The same general order will be observed in the following report as in that of 1883, the articles under consideration being arranged in three groups in consequence of the prominence given to milk by the statutes of 1883, and also by those of 1884, as follows: —

1. Food, in general, with the exception of milk.
2. Milk.
3. Drugs.

The officers acting under the direction of the Board during the year 1884, have been as follows: —

Dr. EDWARD S. WOOD, . . .	Analyst of Food.
Dr. BENNETT F. DAVENPORT, . .	Analyst of Drugs.
Dr. CHARLES HARRINGTON, . . .	Analyst of Milk.
Prof. CHARLES A. GOESSMANN, . .	Analyst of Milk.

In the latter part of 1884 it was also found necessary to employ an assistant in the Department of Milk Inspection, and for this purpose Mr. Charles P. Worcester was employed for such additional work as became necessary.

In the summer of 1884 the work of collecting samples throughout the State, which had previously been done by the analysts themselves, or by such persons as they could temporarily employ for the purpose, was entirely changed and placed upon a more satisfactory basis by the appointment of two inspectors, whose duty, as defined by the regulations of the Board, is solely that of inspection and the collection of samples.

The inspectors appointed were Mr. Hiram R. Neal of Lawrence, and Mr. John H. Terry of Boston.

By the appointment of these inspectors the separation of the work of collection of samples from that of analysis was perfected, and made entirely distinct. The adoption of the regulations which are herewith published has also facilitated the work, and removed some of the difficulties which attended its execution during the first year of work.

Rules and Regulations of the State Board of Health, Lunacy and Charity, relative to the Inspection and Analysis of Food and Drugs.

1. The State Board of Health, Lunacy and Charity shall appoint analysts and inspectors, as provided in section 5 of chapter 263, Acts of 1882.

2. It shall be the duty of the inspectors to procure samples of drugs and articles of food at such times and places as the Health Officer shall direct, in the manner provided in section 6 of chapter 263 of the Acts of 1882, and in section 3 of chapter 289 of the Acts of 1884, and in all acts amendatory of said provisions.

3. Under the direction of the Health Officer, one of the inspectors shall, for the identification of samples, affix a number to each sample of food or drugs obtained by him, beginning with number one, and taking every alternate or odd number thereafter, without limit; and the other inspector shall use and affix each alternate or even number, beginning with number two, and following such form of numbering, without limit, also, as far as may be directed. Under no circumstances shall an inspector convey any information

to an analyst as to the source from which any sample was obtained.

4. The inspectors shall keep records of each sample, each record to include the following items: —

(a) The inspector's number.
(b) The date of purchase or receipt of sample.
(c) The character of the sample.
(d) The name of the vender.
(e) The name of the city or town and street and number where the sample is obtained, and in the case of a licensed milk peddler, the number of his license.
(f) As far as possible, the names of manufacturers, producers, or wholesalers, with marks, brands, or labels stamped or printed upon goods.

5. It shall be the duty of the analysts so appointed, to determine, under the direction of the Health Officer, by proper examination and analysis, whether articles of food and drugs, manufactured for sale, offered for sale, or sold within this Commonwealth, are adulterated within the meaning of chapter 263 of the Acts and Resolves passed by the general court of Massachusetts in 1882, and all acts amendatory thereof, adulteration being defined as follows, viz.: —

In the case of drugs, (1) If sold under or by a name recognized in the United States Pharmacopœia, it differs from the standard of strength, quality or purity laid down therein, unless the order calls for an article inferior to such standard, or unless such difference is made known or so appears to the purchaser at the time of such sale. (2) If, when sold under or by a name not recognized in the United States Pharmacopœia, but which is found in some other pharmacopœia or standard work on Materia Medica, it differs materially from the standard of strength, quality or purity laid down in such work. (3) If its strength or purity falls below the professed standard under which it is sold.

In the case of food, (1) If any substance or substances have been mixed with it, so as to reduce or lower or injuriously affect its quality or strength. (2) If any inferior or cheaper substance or substances have been substituted, wholly or in part, for it. (3) If any valuable constituent has been wholly or in part abstracted from it. (4) If it is an imitation of, or is sold under the name of another article. (5) If it consists wholly or in part of a diseased, decomposed, putrid, or rotten animal or vegetable substance, whether manufactured or not, or in the case of milk, if it is the

product of a diseased animal. (6) If it is colored, coated, polished or powdered, whereby damage is concealed, or if it is made to appear of better or of greater value than it really is. (7) If it contains any added poisonous ingredient, or any ingredient which may render it injurious to the health of the person consuming it.

6. It shall also be the duty of the analysts to receive such specimens of food and drugs for analysis as may be delivered to them by the Health Officer, or by the inspectors, and to examine the same. To avoid, as far as possible, all suggestion or danger of specimens having been tampered with, each analyst shall keep each specimen in his possession in a suitable and secure place, labelled in such a manner as to prevent any person from having access to the same, without the knowledge and presence of the analyst.

Analyses of perishable articles should be made promptly after they are received.

7. An analyst shall give no information, under any circumstances, regarding the result of any analysis to any person except to the Health Officer of the Board, prior to any trial in court in reference to such analysis.

The analysts shall carefully avoid any error regarding the inspector's number attached to each sample, and shall report the results of their work in detail to the Health Officer.

In the case of all articles having a numerical standard provided by statute, the result of the analysis should show their relation to such standard.

8. Before beginning the analysis of any sample, the analyst shall reserve a portion, which shall be sealed, and in the event of finding the portion analyzed to be adulterated, he shall preserve the sealed portion, so that in case of a complaint against any person the last-named portion may, on application, be delivered by the Health Officer to the defendant or to his attorney.

9. Each analyst shall present to the Health Officer, on the Thursday before the first Saturday of each month, a summary of the analyses made by him during the previous month.

Each analyst shall also present, on or before the first of January of each year, an annual report of the work done for the year ending on the 30th of September preceding.

10. The Health Officer shall have charge of the reports of analyses, and shall cause cases founded on such reports to be submitted to the courts for prosecution.

In each case of a retailer, and of every dealer not a manufacturer or producer, he may, if the party has not been previously com-

plained of in court, issue a notice or warning of any violation of the law relative to the adulteration of food and drugs, and of the offender's liability to prosecution on a repetition of the sale.

11. Should the result obtained by any analyst be questioned in any given case, another analyst shall repeat the analysis, unless otherwise instructed by the Board, provided a sufficient sum to meet the expense of the analysis be deposited with the Health Officer by any interested party feeling aggrieved, which sum will not be returned unless the second analysis fails to confirm the first in essential particulars.

12. Any appeal from the decision of an analyst shall be filed with the Health Officer, who shall report it, and any matter in controversy, to the Board, giving his judgment thereon, and the Board shall supervise and control the action of its officers, in executing the law.

13. Where standards of strength, quality or purity are not fixed by the act, the analysts shall present to the Health Officer such standard as in their judgment should be fixed, and the Health Officer shall report the same to the Board for its action. The standards set by the British Society of Public Analysts will be followed as nearly as practicable, until otherwise ordered.

14. Whenever a drug or preparation, not described in a National Pharmacopœia or other standard work on Materia Medica, shall be manufactured, offered for sale, or used in this State, the standard of such drug, and the standard and proportion of the ingredients of such preparation, and the range of variability from such standard or standards shall be ascertained by the analysts, who shall report the same through the Health Officer to the Board.

15. The analysts shall occupy such time in the performance of their respective duties as a reasonable compliance with the terms of the statute shall require, and shall be present one hour of each day, at such time of the day and at such place as shall be designated by the Committee on Health of the Board, to meet the convenience of interested parties and the public.

16. The compensation of the analyst of articles of food shall be at the rate of $1,500 per annum, and that of the analyst of drugs shall be at the rate of $1,000.

That of the analyst of milk for the ten eastern counties of the Commonwealth shall be at the rate of $800 per annum, and that of the analyst of the four western counties shall be at the rate of $500 per annum.

The compensation of each inspector shall be at the rate of $1,000 per annum.

By the provisions of the statutes of 1848, it is required that a portion of each sample found to be adulterated shall be preserved by the chemist and delivered on application to the defendant or to his attorney, in any case submitted for trial in court. In consequence of this provision a considerable quantity of food and drug samples has accumulated at the laboratories where the work of the Board is done. For the better preservation of milk, a refrigerator has been purchased, and samples of this perishable article are kept therein for a reasonable length of time. In a few instances only, defendants have taken advantage of this provision and called for the portions preserved, which have been furnished as the act provides.

Section 11 of the regulations has also proved useful in several instances, particularly, with reference to cream of tartar and spices. Occasionally this provision has been employed for purposes similar to that detailed in the following instance. A gentleman called at the Health Office, and produced a sample of white powder, purchased for cream of tartar, at the same time alleging that it was grossly adulterated. In support of this charge, the following characteristics were stated as tests: —

1. Bread prepared with the powder was not good.
2. The powder was heavy.
3. It had a gritty feel, like sand.
4. It would not dissolve in water. To illustrate this point a bottle was produced, filled with cold water, containing a considerable quantity of the white powder undissolved at the bottom.

No analyst would accept any one or all of these tests as conclusive in the absence of a thorough analysis, for the following reasons: —

1. Without the greatest care and a proper regard to the quantity and strength of the alkali employed as a neutralizing agent, even the best cook may produce a bad loaf of bread.
2. Cream of tartar is a comparatively heavy salt.
3. Its crystalline form gives it the gritty feel complained of.
4. It will dissolve but sparingly in cold water.

In consequence of the charge of adulteration (the person presenting the article alleging that it was adulterated with white sand), the sample was submitted to one of the chemists of the Board, who reported it after careful analysis as an unusually pure cream of tartar without the slightest trace of admixture of any foreign substance.

The purchaser was still unconvinced. The remainder of the sample was then divided into three parts, each of which was submitted to a different analyst, neither of whom was aware of its source. The results were exactly the same in each case, and corresponded with the first analysis. This incident also illustrates, not only the prevalence of adulteration, but also a consequent tendency in certain instances to prefer the bad to the good, in consequence of a want of knowledge of the true characteristics of the latter. The same fact is also often noticed with regard to milk. When artificially colored, though of exceedingly poor quality, it is not uncommonly preferred to milk of excellent quality which has not been colored.

The first year's work of the Board, detailed in the last supplementary report, was conducted by chemists without the assistance of inspectors, and consisted mainly of inspection and analysis with but little executive work, no prosecutions being made until December, 1883. That year was mainly spent in ascertaining the extent of adulteration, and in a general examination of the food supply. The result of that examination showed quite clearly that adulteration, while very commonly practised, was limited to certain kinds of food, and also of drugs, usually the more expensive sorts. Familiarity with this fact, therefore, facilitates the work of inspection, and enables the inspector to limit his work to such articles as are liable to adulteration, and to make his selection of samples mainly from those which are known to be subject to fraud.

The management of the first cases which were entered in the courts for violation of the existing laws was entrusted to an attorney, but latterly the inspectors, having become familiar with the work, have conducted the prosecutions without assistance. Much care has been taken to trace, as far as

possible, such cases of adulteration as have come to our notice, to their source. Warnings have been sent to all parties found selling adulterated goods, excepting producers and manufacturers or wholesale dealers, who are supposed to be aware of the quality of the articles which they furnish. This plan adopted during the previous year has been productive of excellent results. The retailer from whom the original sample for analysis is usually obtained sends the notice immediately to the party from whom the goods are obtained.

In order to facilitate the work of the departments in this direction, the following blanks have been prepared.

[Stub.]

Boston,..............................*188*

Notice sent to..............................

....

doing business at No...............................

..............................*Street,*..............................

..............................*Mass.*

Character of Sample (state whether an article of Food or a Drug, and specify its nature),..............................

....

....

....

How adulterated,..............................

....

....

....

First or second offence,..............................

Prosecution, results of,..............................

....

Name of analyst,..............................

....

See Acts relating to the Adulteration of Food and Drugs, chap. 263, Acts of 1882, and chap. 289, Acts of 1884.

[Form 1.]

COMMONWEALTH OF MASSACHUSETTS.

STATE BOARD OF HEALTH, LUNACY AND CHARITY.

DEPARTMENT OF HEALTH, STATE HOUSE.

Boston, Mass.,..............................*188*

You are hereby informed that a sample of..............................

marked..............................*, recently purchased at your place of business, was found on analysis not to conform to the requirement of the Statutes. You are respectfully warned that a repetition of its sale will render you liable to prosecution according to law.*

Respectfully yours,

To..............................

....

....

Health Officer.

[Form 2.]

COMMONWEALTH OF MASSACHUSETTS.

STATE BOARD OF HEALTH, LUNACY AND CHARITY.

INSPECTION AND ANALYSIS OF MILK.

Report of ______________________________, *Analyst.*

No.	Date of Purchase.	Name of Person from whom Purchased.	Place of Business. Street and Number.	Name of City or Town.	Quantity Purchased.	Price Paid	Result of Analysis.							Remarks.
							Temperature.	Specific Gravity.	Fat.	Solids not Fat.	Total Solids.	Water.	Ash.	

____
Analyst.

____
Collector.

[Form 3.]

COMMONWEALTH OF MASSACHUSETTS.

STATE BOARD OF HEALTH, LUNACY AND CHARITY.

INSPECTION AND ANALYSIS OF MILK.

(Samples of known purity.).

Report of ...., *Analyst.*

1	2	3	4	5	6	7	8							9
No.	Time of Milking.	Where Obtained.	Age of Cow.	Time since Calving.	Breed.	Character of Feed.	Results of Analysis.							Remarks.
							Specific Gravity.	Fat.	Sugar.	Albuminoids.	Ash.	Total Solids.	Water.	
1														
2														
3														
4														
5														
6														

Columns 1, 2, 3, 6 and 7 should be filled by the Collector, at the time and place of milking, the cows producing the samples to be milked in his presence. Each sample should represent a mixed milk, from several animals, unless otherwise directed. Columns 4 and 5 are to be filled only when milk is obtained from single animals.

This blank report should accompany each lot of samples to the analyst, who will please fill columns 8 and 9.

Signed, ...

Analyst.

Boston, ... *188* .

[Form 4]

COMMONWEALTH OF MASSACHUSETTS.

STATE BOARD OF HEALTH, LUNACY AND CHARITY.

INSPECTION AND ANALYSIS OF FOOD.

Report of ...., *Analyst.*

No.	Date of Purchase.	Character of Sample.	Name of Person from whom Purchased.	Place of Business. Street and Number.	Name of City or Town.	Quantity Purchased.	Price Paid	Result of Analysis.	Remarks.

Signed,

Collector. *Analyst.*

Boston, ... *188* .

[**Form 6.**]

COMMONWEALTH OF MASSACHUSETTS.

STATE BOARD OF HEALTH, LUNACY AND CHARITY,

Department of Health, State House.

INSPECTION AND ANALYSIS OF FOOD AND DRUGS.

Boston, ... *188* .

Dear Sir:

A sample of ....

having been deposited by you at this office for analysis, on the .... *day of* ...., *I have forwarded the same to* ...., *an analyst appointed by the State Board of Health, Lunacy and Charity, and herewith submit his report.*

RESULT OF ANALYSIS.

....

....

....

....

....

....

Respectfully yours,

....

Health Officer.

To ....

....

[Form 7.]

Health Department. Inspection of Food and Drugs.

No.	Date of Purchase.	Character of Sample.	Name of Seller.	City or Town.	Street and Number.	Quantity Bought.	Price Paid.		REMARKS.

[Form 8.]

COMMONWEALTH OF MASSACHUSETTS.

STATE BOARD OF HEALTH, LUNACY AND CHARITY.

HEALTH DEPARTMENT.

Report of Prosecutions for the quarter ending ....

No.	DATE OF ENTRY OF COMPLAINT.	NAME OF PARTY.	PLACE OF BUSINESS. Street and Number.	NAME OF CITY OR TOWN.	CHARACTER OF SAMPLE.	RESULT OF PROSECUTION.	FINAL DISPOSAL OF CASE.

....

Inspector.

Boston, ... *188* .

Form 1 is used for the purpose of warning or notifying any one that a sample purchased or obtained of him does not conform to the requirements of the Statutes. Its uses have already been explained. These blanks are bound in book form, and the stub constitutes a record of each case of sale of adulterated articles. Other record books contain the information obtained from these forms arranged and indexed for future reference, each city and town being indexed separately.

Form 2 is sufficiently plain as to require no explanation. It constitutes a complete record of each sample of milk obtained by the inspectors, whether from shops, carts, contractors or producers.

Form 3 is used for a separate and distinct department of work, — as important in itself as that of inspection, — and requiring as much care in its supervision. The examination of samples of milk of *known purity* is made with great care, the samples being first taken by the inspectors who witness the milking under careful instructions. The report of this branch of work will be found in Dr. Harrington's report under Class E, and also in the report of Prof. Goessmann's work for Western Massachusetts.

Forms 4 and 5 are similar in their uses to Form 2. Form 5 is omitted on account of its similarity to Form 4. It is used for the records of Drug inspection.

Form 6 is employed for reporting the results of single cases of analysis. In consequence of the liability to abuse of such a form, it has been sparingly used.

Form 7 is that of the pocket-record used by inspectors. The data from which forms 2, 3, 4 and 5 are made up are obtained from these books and from the records of the analysis; these two records being compiled at the office of the Health Department. In conformity with the regulations the only data known in common by the inspectors and by the analysts are the numbers attached to the samples.

Form 8 is used for the quarterly reports of prosecutions, and is made out by the inspectors.

Prosecutions.

The whole number of prosecutions conducted during the year 1884 was forty-eight. Of this number there were for the sale of —

Adulterated	drugs	in Boston,	one case.
"	vinegar	in Somerville,	one case.
"	butter	in Boston,	one case.
"	milk	in Boston,	five cases.
"	"	in Lynn,	seventeen cases.
"	"	in Cambridge,	eight cases.
"	"	in Fall River,	three cases.
"	"	in Worcester,	two cases
"	"	in Chelsea,	one case.
"	"	in Brockton,	one case.
"	"	in Harvard,	three cases.
"	"	in Bolton,	one case.
"	"	in Norwood,	one case.
"	"	in Holliston,	three cases.
Total			48

Of this number convictions were obtained in 44 cases. Of these several appealed and were held for trial in the superior court, 18 in number, nine of which afterward paid costs of trial having withdrawn their appeal. Four cases were discharged, one in consequence of the court requiring that knowledge of the fact of adulteration should be proven on the part of the defendant, one in consequence of a faulty warrant, and two in consequence of refusal of the court to try the case for want of jurisdiction. This difficulty has been remedied by the Legislature of 1885, by the enactment of a statute providing that the district courts and trial justices shall have jurisdiction in all milk cases.

Food.

In this department the work of the analysts has embraced the following articles — the list being larger than that of 1883, as follows: Butter, Cheese, Lard, Coffee (raw, roasted and ground), Tea, Confectionery, Honey, Sugar, Syrups, Olive Oil, Soda, Vinegar (white wine and cider), Baking Powders, Cream of Tartar, Pickles, white, black and Cayenne Pepper, Mustard, Ginger, Cloves, Cinnamon, Cassia, All-

spice, Mace, Horseradish, and the Essences of Lemon and Vanilla.

Samples of these articles of food have been collected quite generally throughout the State in the cities and large towns, as follows: Boston, including Roxbury, East and South Boston, Charlestown and Brighton, Chelsea, Worcester, Lowell, Fall River, Cambridge, Lynn, Lawrence, Salem, Somerville, Haverhill, Newburyport, Taunton, Brockton, Newton, New Bedford, North Adams, Natick, Woburn, Quincy, Brookline, South Framingham and Athol. In many instances, small towns receive their supplies from larger towns or cities in the neighborhood, and protection afforded to the latter must necessarily extend to the former also.

The result of the examinations conducted during the years 1883 and 1884, shows that adulteration is limited to certain sorts of food, while other kinds, and especially some of the great staple articles, such as most of the manufactured cereal products, wheat flour, meal of all kinds, and sugar are comparatively free from adulteration. The work of the Board, therefore, which during its earlier investigations was largely experimental, has during the past year been limited chiefly to such articles as are subject to adulteration. This has been the plan pursued both in France and in England, where inspection has gradually been narrowed and limited to the line of suspicious goods.

The number of prosecutions, or complaints against parties selling adulterated goods represents but a trifling portion of the actual work done, or of the good accomplished under the present laws. In the case of articles of food sold everywhere by grocers and subject to adulteration, where such adulteration exists the fault is commonly that of the manufacturer. A marked variation in price from that of a pure article ought, however, to put the retailer on his guard. Such is especially the case with reference to cream of tartar, olive oil and spices of various sorts.

Vinegar.

The Public Statutes of 1882 provided that commercial vinegar must contain at least 5 per cent. of acetic acid, and $1\frac{1}{2}$ per cent. of solids. Acting in conformity to this standard, a large number of samples were taken during the year

in different parts of the State, and were submitted to analysis. The summary of these analyses will be found in the report of the Food Analyst. The evidence as to methods of manufacture must be obtained largely from the manufacturers and the farmers. Such evidence has shown that certain elements of importance enter into the manufacture of vinegar, and largely affect the result with reference to its quality. These are the season of the year, exposure to the air, quality of fruit used, heat, and the length of time required for its manufacture. Partially as a result of the evidence presented by manufacturers, and partially in consequence of the results of analyses made by the Board, the Legislature of 1885 have fixed the standard of this article at $4\frac{1}{2}$ per cent. and 2 per cent. of solids.

The provisions of the General Food Act of 1882 do not apply to mixtures or compounds recognized as ordinary articles of food, provided the same are not injurious to health, and are distinctly labelled as mixtures or compounds. In many instances, especially in the case of spices, an attempt to evade the law has been clearly evident. Examples of such evasion of the law will be found detailed in the Report of the Food Analyst.

The number of warnings issued to parties selling adulterated articles during the year 1884, was as follows: —

Food,	132
Milk,	276
Drugs,	25
Total,	433

Milk.

In the last Supplementary Report of the Board (p. 94, Fifth Annual Report, Supplement), the introductory statement relative to the subject of milk related chiefly to its quantity, value and quality as produced in Massachusetts.

The conclusions derived from the work of the Board for the year 1884 fully sustain the statements made in the former report, especially with reference to the quality of milk, as produced by the cow, and also as sold to the consumer.

As will be seen by the report of the analysts, in addition to the work of inspection performed by the Board through the year, special attention has also been given to the subject of natural milk as produced by the cow. Great care has been taken in the procuring of samples of this class in order that the results should be recorded with the greatest possible accuracy. These samples have been taken from large herds of cattle at the public institutions of the State, as well as from private farms and dairies.

The work of inspection has been conducted quite uniformly throughout all the cities of the State and also in many of the large towns. The result of this examination has proved the truth of the statement in the last annual report, that the adulteration of milk is far more common in eastern Massachusetts than in the western counties of the State. Cases west of Worcester County are of rare occurrence. The most flagrant violation of the law was found in the city of Lynn, where impure milk appears to have been the rule and not the exception. In one lot of 16 samples obtained in that city from carts and shops in August, 1884, not one conformed to the requirement of the statutes.

In all of the cities and large towns of the State, the quality of milk sold to consumers has shown a marked improvement since the present law went into effect, and those municipalities have been frequently visited by the inspectors acting under instructions from the Health Department.

Since the enactment of laws requiring the State Board to take cognizance of the subject of food adulteration, and especially of that of milk and its products, a greater interest has been manifested by cities and also by some of the larger towns in the protection of their citizens. In some of the cities efficient service has apparently been rendered, so far as can be ascertained from the published reports. It is evident, however, that the compensation has generally been very inadequate when compared with the work done and the results accomplished.

Reports have been received by the State Board from the milk inspectors of nine cities, as follows: Boston, Lynn, Malden, Holyoke, Springfield, Newburyport, Taunton, Worcester and Gloucester. In a part of the remaining

cities no inspectors have been appointed, and in others no reports have been published where inspectors were appointed.

From these reports it appears that between five and six thousand samples of milk were taken for inspection by local officers during the year, of which number about 1,500 were submitted to chemical analysis.

The greater part of the work done was performed in the city of Boston. The reports of the Boston inspector, as well as those of Malden and Lynn, are especially commendable, and communicate valuable information as to the inspection of milk.

The amount reported as sold in Boston for 1884 was 36,000 cans daily, valued at $5,256,000 per year.

The amount sold in Lynn was reported as 3,500,000 quarts annually.

The statutes prescribe a fixed and definite standard for commercial milk. Milk not containing 13 per cent. of solids is deemed to be adulterated under the law. It is often urged that under such a standard, milk as obtained direct from the animal does not always conform to the requirement of the law. While this is true, it is also evident that a standard established at the minimum of quality, or that of the poorest milk obtained under the worst conditions, would admit of the sale of a very large quantity of adulterated milk.

It is possible to produce from inferior animals, under unfavorable conditions, such as impoverished diet, bad care, extreme age or youth, milk somewhat below the legal requirement. This ought not to be an argument for the reduction of the standard to include occasional cases of the lowest quality.

Mixed milk contains a greater amount of solids than its minimum constituents. Hence, the milk producer or dealer will find it a safe rule to sell mixed milk only, especially when his herd contains one or more animals producing milk of a poor quality. In the 40-quart cans of the Housatonic Valley, filled for the New York market, the milk must necessarily be a mixture from several animals; but in the case of the usual 2-gallon can, so largely in use throughout the larger part of the State, the contents may be often that of two or

three animals only, and it occasionally may represent a single animal.

The present law applies to articles of food which are adulterated, and hence also, indirectly, it has an effect upon the articles which are used for the purpose of adulteration. Of this latter class are the various materials employed for the purpose of coloring milk, butter and cheese, which are sold in considerable quantities by druggists, grocers and others, and occasionally by special agents, or manufacturers, as the following correspondence shows: —

——— Mass., October 25.

Dear Sir: — I would like to call your attention to —— for which I am the agent. It is the article which all milkmen in Boston and vicinity use to *improve* the quality of their milk, and to help them out when milk is scarce. It is perfectly harmless, and the *milk inspectors and state board of health cannot detect it* in the milk. The amount of water you can add to your milk in one day without detection will pay for —— enough to use three months. If you have any friends in the business please tell them of this.

Yours truly,

——————

——— Mass., Nov. 8, 1884.

Dear Sir: — Yours received. Sent by Adams Express one bottle —— * * * * give it a good trial. Don't be afraid of the color, taste or smell, as you will find it to be all right when in the milk. A sample of milk taken from a batch put up with —— and analyzed will prove to the inspector to be all right, as the —— *counteracts the chemicals they have to use in the analysis.*

Yours truly,

——————

Directions also accompanied the above letter, in which, after specifying the amount of water, sugar and salt to be used in addition to the coloring matter, the writer adds, in a refreshing style: "*If you take cream off from the milk, add a trifle more. Some don't use sugar only when sticking their milk pretty hard. It gives it a good body however.*"

The sale of such an article is evidently entirely in the interest of fraud and dishonest dealing, and a statute which would prevent its sale would prove a benefit to the consumer

and the honest dealer, if not to the parties engaged in such traffic.

The following statutes were enacted by the Legislature of 1885, relating mainly to the proper marking of oleomargarine and other forms of spurious butter, the powers and duties of inspectors, and also to a more definite standard of milk and also of skimmed milk, the latter having become an article of sale in considerable quantities. Skimmed milk has a definite value as an article of food, and there can be no objection to its sale, provided that its quality is made known to the consumer or purchaser.

[CHAP. 352.]

AN ACT IN RELATION TO THE INSPECTION AND SALE OF MILK AND BUTTER.

Be it enacted by the Senate and House of Representatives in General Court assembled as follows:

SECT. 1. Section seventeen of chapter fifty-six of the Public Statutes is hereby amended so as to read as follows: — Whoever, by himself or his agents, sells, exposes for sale, or has in his possession with intent to sell, any article, substance or compound, made in imitation or semblance of butter or as a substitute for butter and not made exclusively and wholly of milk or cream, or containing any fats, oils or grease not produced from milk or cream, shall have the words "imitation butter," or if such substitute is the compound known as "oleomargarine," then the word "oleomargarine," or if it is known as "butterine," then the word "butterine," stamped, labelled or marked in printed letters of plain uncondensed Gothic type, not less than one-half inch in length; so that said words cannot be easily defaced, upon the top and side of every tub, firkin, box or package containing any of said article, substance or compound. And in cases of retail sales of any of said article, substance or compound, not in the original packages, the seller shall, by himself or his agents, attach to each package so sold, and shall deliver therewith to the purchaser, a label or wrapper bearing in a conspicuous place upon the outside of the package the words "imitation butter," "oleomargarine," or "butterine" as the article may be, in printed letters of plain uncondensed Gothic type, not less than one-half inch in length.

SECT. 2. Section eighteen of chapter fifty-six of the Public Statutes is hereby amended by striking out the word "Roman" in the seventh and seventeenth lines, and inserting in place thereof the words "uncondensed Gothic."

SECT. 3. Section nineteen of chapter fifty-six of the Public Statutes is hereby amended by inserting after the word "of" and before the word "any" in the seventh line the words "or in any manner shall falsely label, stamp or mark."

Sect. 4. Section two of chapter fifty-seven of the Public Statutes is amended so as to read as follows: — Such inspectors shall keep an office and shall record in books kept for the purpose the names and places of business of all persons engaged in the sale of milk within their city or town. Said inspectors or their assistants may enter all places where milk is stored or kept for sale, and all carriages used for the conveyance of milk, and the said inspectors or their assistants may take samples for analysis from all such places or carriages. The inspectors shall cause the samples of milk so taken to be analyzed or otherwise satisfactorily tested, the results of which analysis or test they shall record and preserve as evidence. The inspectors shall receive such compensation as the mayor and aldermen or selectmen may determine.

Sect. 5. Inspectors appointed under the provisions of chapter two hundred and sixty-three of the acts of the year eighteen hundred and eighty-two shall have the power and authority conferred upon a city or town inspector by the preceding section. They shall also have the power and authority conferred upon inspectors of milk by section twenty of chapter fifty-six of the Public Statutes.

Sect. 6. Section nine of chapter fifty-seven of the Public Statutes is hereby amended so as to read as follows: — In all prosecutions under this chapter, if the milk is shown upon analysis to contain more than eighty-seven per cent. of watery fluid, or to contain less than thirteen per cent. of milk solids (or to contain less than nine and three-tenths per cent. of milk solids exclusive of fat), it shall be deemed for the purposes of this chapter to be adulterated.

Sect. 7. Section seven of chapter fifty-seven of the Public Statutes is hereby amended by inserting after the word "in" and before the word "letters" in the seventh line the words "uncondensed Gothic."

Sect. 8. No person shall sell, exchange or deliver or have in his custody or possession with intent to sell, exchange or deliver skimmed milk containing less than nine and three-tenths per cent. of milk solids exclusive of fat. Whoever violates the provisions of this section shall be punished by the penalties provided in section five of chapter fifty-seven of the Public Statutes.

Sect. 9. This act shall take effect upon its passage. [*Approved June 18, 1885.*

Drugs.

During the year the collection and analysis of drugs was confined mainly to pharmacopœial articles, and samples were collected from all parts of the State, mainly of such drugs as have a definite form of analysis prescribed by the Pharmcopœia. Many officinal preparations have no such definite method prescribed, and of such drugs but few samples have been collected for inspection. Among them may be named the very large class of Fluid Extracts of the Pharmacopœia.

The plan of issuing notices or warnings to such druggists as are found delinquent, has been continued throughout the year with excellent effect. Many druggists have expressed entire satisfaction at the work of the Board, and acknowledged its usefulness.

In the work of collection of drugs throughout the State, the inspectors have acted as collectors only, the work of supervision having been conducted by the health officer, who has directed the operations of the collectors, prescribing the articles to be collected, and also the time and place of their collection. The special method employed for obtaining samples is as follows : an order calling for five or six samples of the drugs desired for analysis is presented at any drug store in the State, each sample being purchased in sufficient quantity for such an analysis or inspection. By this method of operation, articles are obtained in the condition and quality in which they are sold to consumers.

The following is an example of one of the orders referred to above :

Spirits of Nitrous Ether (U. S. P.), . . .	2 ounces.
Iodide of Potassium (U. S. P.), ...	1 ounce.
Citrate of Iron and Quinine (U. S. P.) (1880), .	½ ounce.
Powdered Jalap (U. S. P.), ...	½ ounce.
Solution of Chlorinated Soda (U. S. P.), . .	3 ounces.

To avoid all possibility of error, the quantities are written in full, this method being preferable to the ancient symbols still in use for ounces, drachms and scruples, and less liable to mistake. The adoption of this plan in the writing of prescriptions would prove to be safer to the purchaser or patient, more intelligible to the compounder, and in every way more satisfactory to all who are concerned. Better than either would be the general adoption of the metric system by all physicians and apothecaries. By its use pharmaceutical operations would be facilitated, the compounding of prescriptions would be performed more quickly and more safely, and intercourse and correspondence with the enlightened people of other countries would be made more free and intelligible.

The order of which the example given is a fair sample is not in any case a prescription to be compounded, each line representing a separate article to be put up in a separate package and marked by the inspector, who transmits it by number only to the chemist in the same manner as is provided in the case of articles of food.

A considerable number of cases of adulteration detected among officinal drugs sold at retail shops consists in a departure from the required standard of quality as defined in the United States Pharmacopœia, and is apparently due, in many instances, to ignorance or carelessness in methods of preparation, especially in the case of such articles as are compounded by the retailer himself. On the other hand, certain articles, chiefly those of an expensive sort, are subject to adulteration by means of the substitution of inferior ingredients.

Among the former class may be named many of the opium and quinine preparations, the pharmacopœial spirits and wines, and certain powdered drugs. Among the latter are compound spirits of ether, in which the ethereal oil is substituted by an inferior oil; saffron, replaced by safflower; cream of tartar (occasionally, though rarely when sold as a drug), adulterated with various cheaper articles.

A considerable number of articles used as food, or in its preparation, are also sold by druggists, either as drugs, or occasionally for food purposes, — such as mustard and other spices or condiments, cream of tartar, soda, arrow-root, etc. In general the average quality of such articles as sold by the druggist is much better than the average as sold by the grocer. On the other hand, there are a few common drugs, such as sulphate of magnesia, castor oil, sulphur, and various opium preparations, which are sold by grocers as well as by druggists. Of the last named — the opium preparations, and especially the stronger — it should be said that the sale of potent drugs of this sort should be restricted to druggists and apothecaries.

REPORT OF THE ANALYST OF FOOD.

PROF. EDWARD S. WOOD, M. D.

REPORT OF THE ANALYST OF FOOD.

Boston, Mass., January, 1885.

Dr. S. W. Abbott, *Health Officer*,
State House, Boston, Mass.

Dear Sir: — I have the honor to present my second annual report on the examination of foods. I have received and examined one thousand two hundred and thirty-six samples, somewhat less than one-half of which proved to be adulterated. The fact that so large a proportion of the samples received proved to be impure is not, however, to be accepted as an indication that but little more than half of the food supply is free from adulterations, for the inspectors and other persons collecting samples avoid as much as possible purchasing goods which they know or have reason to suppose to be pure. Moreover, certain foods such as flour, the various meals, the high grade sugars, etc., which, experience has shown, are not subject to any extensive adulteration, have not been collected in any numbers.

The general food-supply is very much better in quality than it was at the time of my first report, and a constant improvement is remarked. Very many of the brands of adulterated mustard, cream of tartar, spices, etc., have been driven from the markets, and a greater desire on the part of retailers to handle none but pure goods is very general. The issuing of warnings to retailers whose goods prove to be impure, has been productive of most marked good results; a person once warned is rendered more careful in the selection of goods, and is more or less restrained from tampering with foods which he may have purchased pure. I have received a great number of samples which were purchased of persons who had been already warned that certain articles in their shops were adulterated, and that they were liable to

prosecution for selling the same; in the great majority of instances the second samples have proved to be pure. The effect of a warning is twofold: first, it acts upon the person receiving it; and second, it has the effect on the wholesaler or manufacturer whom it is difficult to reach more directly.

I desire to call your attention to the manner in which a certain clause of the food law is interpreted by many manufacturers and dealers; the law states that its provisions "shall not apply to mixtures or compounds recognized as ordinary articles of food, provided that the same are not injurious to health, and are distinctly labelled as mixtures or compounds." This seems to be interpreted by many as meaning, that if the word "compound" or "compounded" is introduced either alone or in the construction of sentences on the label, the sale of inferior adulterated articles is permissible. The law reads that they shall be *distinctly* labelled as mixtures or compounds, but it does not specify what shall be considered as distinct. In many cases, the word "compound" occurs in very clear and finely cut, but almost microscopic letters; it is frequently brought into a sentence in such a way as to be itself, and render the sentence, devoid of meaning. It is often printed in the margin of a label which warrants the contents of the package to be strictly pure; and it is very commonly placed on the back or side of the package where it is most likely to be overlooked. A very ingenious method of complying with and beating round the law, is one which has come under my observation several times; a certain brand of cream of tartar is labelled "Pure Cream of Tartar $\frac{1}{4}$ pound," and at a distance of a few feet nothing peculiar is to be observed, but on close inspection it may be seen that the word "Pure," which is printed in Gothic type in dark blue ink, bears the word "Compound" in very small black type, each letter of the former bearing two letters of the latter word. This is hardly "distinct."

There is a brand of mustard which has considerable sale in and about Boston, which bears upon the label the following: —"This can of Mustard is perfectly pure, and as several parties are putting up a cheap poor mustard in the same style can, be sure and call for the —— brand"; then in very small letters the word "compound." The following are

examples of the manner in which the law is followed: "Pure compounded Cream of Tartar"; "Strictly pure Pepper, compounded at —— Mills"; "Warranted to be the purest compound"; "This superior brand is compounded from the finest crude stock"; "Warranted Pure Ground Cloves, compounded expressly for A. B., etc."; "Pure Compound Cassia put up for Family Use." Comment is unnecessary.

The foods examined during the year include vinegar, olive oil, lard, butter, cheese, sugar, honey, candy, tea, coffee, mustard, spices, cream of tartar and baking powders, canned foods, pickles, meat extracts, flavoring extracts, etc., etc.

Vinegar.

I received 273 samples, including cider vinegar and white-wine vinegar; 52 were above the statute standard of 5 per cent. of acetic acid, and 221 were below; 109 of the latter contained more than 4 per cent. of acetic acid. The strongest sample of the whole number contained 8.83 per cent., and the weakest contained but 0.66 per cent. The acidity of one sample which contained kerosene oil was not estimated; the presence of kerosene was probably accidental.

Inspector's Number.	Per Cent. Acetic Acid.	Inspector's Number.	Per Cent. Acetic Acid.
329,	8.83	273,	5.73
337,	8.67	243,	5.70
1334,	7.68	188,	5.64
1066,	6.80	225,	5.64
194,	6.60	475,	5.64
15,	6.36	1097,	5.55
242,	6.36	1076,	5.50
186,	6.33	245,	5.46
433,	6.31	1865,	5.45
1085,	6.17	1861,	5.40
234,	6 12	1095,	5.37
183,	6.03	145,	5.34
232,	6.00	1310,	5 33
1065,	5.80	322,	5.32
173,	5.76	1063,	5.32
266,	5.73	20,	5.31

Inspector's Number.	Per Cent. Acetic Acid.	Inspector's Number.	Per Cent. Acetic Acid.
527, ...	5.30	1308, ...	4.78
233, ...	5.25	144, ...	4.77
288, ...	5.25	276, ...	4.77
1261, ...	5.21	290, ...	4.77
172, ...	5.19	94, ...	4.74
99, ...	5.16	198, ...	4.74
546, ...	5.16	213, ...	4 74
167, ...	5.10	379, ...	4.74
231, ...	5.10	445, ...	4.74
240, ...	5.10	1282, ...	4.74
1256, ...	5.09	1863, ...	4.73
235, ...	5.08	1190, ...	4.70
19, ...	5.07	1330, ...	4.70
508, ...	5.06	1339, ...	4.70
227, ...	5.04	1773, ...	4.70
248, ...	5.04	219, ...	4.68
332, ...	5.03	222, ...	4.68
1064, ...	5.03	514, ...	4.68
150, ...	5.01	279, ...	4.67
1067, ...	5 00	426, ...	4 67
1096, ...	4 98	96, ...	4.65
305, ...	4.96	429, ...	4.64
1092, ...	4.93	309, ...	4.63
1086, ...	4 92	313, ...	4.63
1311, ...	4.92	1071, ...	4.63
262, ...	4.90	1089, ...	4 63
1068, ...	4.90	1301, ...	4.63
98, ...	4.89	163, ...	4.62
256, ...	4.88	161, ...	4.59
212, ...	4 86	448, ...	4 57
229, ...	4.86	230, ...	4.56
285, ...	4.86	420, ...	4 55
1192, ...	4.86	442, ...	4.55
1869, ...	4.86	1268, ...	4.51
363, ...	4.83	21, ...	4.50
1312, ...	4.82	250, ...	4 50
228, ...	4.80	575, ...	4.48
317, ...	4.80	1073, ...	4.48
1267, ...	4.80	1313, ...	4 48

Inspector's Number.	Per Cent. Acetic Acid.	Inspector's Number.	Per Cent. Acetic Acid.
494,	4.47	1074,	4.17
17,	4.44	244,	4.14
162,	4.44	327,	4.14
190,	4.44	1314,	4.14
215,	4.44	292,	4.13
1299,	4.44	295,	4.12
298,	4.43	336,	4.10
239,	4.41	1763,	4.09
405,	4.39	1274,	4.04
509,	4.38	218,	4.02
1070,	4.37	1360,	4.02
16,	4.35	450,	4.00
1265,	4.34	1322,	3.98
1072,	4.33	409,	3.97
175,	4.32	1263,	3.97
207,	4.32	567,	3.96
246,	4.32	1319,	3.96
1338,	4.32	518,	3.95
1358,	4.30	401,	3.94
18,	4.29	97,	3.93
238,	4.28	165,	3.93
1098,	4.28	1195,	3.93
330,	4.27	1359,	3.93
1298,	4.27	1259,	3.91
1363,	4.27	177,	3.90
95,	4.26	1078,	3.90
182,	4.26	1271,	3.89
217,	4.26	1302,	3.89
236,	4.26	1305,	3.89
	4.25	1783,	3.89
191,	4.23	510,	3.88
171,	4.20	92,	3.87
206,	4.20	1256,	3.87
335,	4.20	565,	3.86
1309,	4.20	160,	3.84
1304,	4.18	209,	3.84
333,	4.18	210,	3.84
333,	4.17	1260,	3.84
423,	4.17	1062,	3.83

Inspector's Number.	Per Cent. Acetic Acid.	Inspector's Number.	Per Cent. Acetic Acid.
1258, ...	3.83	536, ...	3.36
369, ...	3.82	550, ...	3.35
1083, ...	3.80	1357, ...	3.34
1307, ...	3.80	334, ...	3 33
1320, ...	3.79	1191, ...	3.33
93, ...	3.78	351, ...	3 32
390, ...	3.77	530, ...	3.30
1094, ...	3.77	1091, ...	3.23
179, ...	3.75	201, ...	3.21
1088, ...	3.75	1278, ...	3 19
1266, ...	3.75	166, ...	3.15
1356, ...	3 74	562, ...	3.14
1335, ...	3.73	571, ...	3 14
1300, ...	3.72	1315, ...	3.14
168, ...	3.69	1871, ...	3.13
237, ...	3.69	1267, ...	3.11
400, ...	3.67	1273, ...	3.10
169, ...	3.66	1254, ...	3.08
170, ...	3.66	1194, ...	3 07
1264, ...	3.64	561, ...	3.02
1332, ...	3 63	14, ...	3.00
1081, ...	3.62	226, ...	3.00
1336, ...	3.62	1306, ...	3.00
1362, ...	3.62	1279, ...	2.95
143, ...	3 60	1262, ...	2.94
338, ...	3.60	1257, ...	2.92
1193, ...	3.58	1275, ...	2 92
1303, ...	3.58	477, ...	2 88
331, ...	3.57	532, ...	2.88
1075, ...	3.56	1272, ...	2.88
1276, ...	3 56	476, ...	2.72
1317, ...	9.56	551, ...	2.64
1331, ...	3.56	547, ...	2.62
241, ...	3 54	356, ...	2.60
1316, ...	3.54	1069, ...	2.60
1318, ...	3.54	1277, ...	2.47
387, ...	3.52	1321, ...	2.45
164, ...	3.51	1270, ...	2.38
1337, ...	3.43	457, ...	2.37

Inspector's Number.	Per Cent. Acetic Acid.	Inspector's Nxmber.	Per Cent. Acetic Acid.
1280, ...	2.11	533, ...	1.49
537, ...	2.10	371, ...	0.66
1867, ...	1.87	1281,*	-
515, ...	1.60		

* Contained kerosene.

Olive Oil.

Seventy-six (76) samples were received; twenty-one (21) were genuine, and fifty-five (55) were cheap substitutes. The latter included twelve different brands, as follows: —

"Huile d'Olive Vierge. E. Loubon, Nice, F. A. O."
"Huile d'Olive Vierge. E. Loubon, Nice. D. 126."
"R. L. Dacosini, Nantes. Huile d'Olive Surfine Clarifiée."
"Huile d'Olive Surfine Clarifiée. R. L. Dacosini, Nice."
"Superfin Huile d'Olive. Nice."
"Huile d'Olive Vierge d'Aix. Bordeaux."
"B. Dufour & Cie. Huile d'Olive Superfine Clarifiée."
"Huile d'Olive Vierge. A. Seguin, Nice."
"Orient Frères, Bordeaux. Huile d'Olive Vierge."
"Huile d'Olive d'Aix. Berger Frères, Bordeaux."
"Pure Olive Oil, prepared by J. L. Pynchon."
"Olive Oil."

The inspectors' numbers of the spurious samples were 234*a*, 236*a*, 237*a*, 240*a*, 242*a*, 244*a*, 245*a*, 246*a*, 247*a*, 251*a*, 252*a*, 255*a*, 257*a*, 259*a*, 261*a*, 262*a*, 263*a*, 287*a*, 77, 1001, 1007, 1018, 1031, 193, 197, 202, 247, 249, 251, 297, 323, 1060, 1084, 1111, 1127, 1131, 350, 355, 368, 370, 1165, 1176, 380, 383, 1252, 483, 483, 1377, 1389, 1393, 1397, 1400, 1403, 1407 and 1409.

The twenty-one genuine samples were represented by eight different brands.

Lard.

I received 15 samples, all but one of which (No. 264*a*) proved to be good. This single exception was dark-colored and of very unpleasant odor. It was adulterated in the sense that it was old, spoiled and unwholesome.

Cheese.

Twelve (12) samples were received and examined, particularly for lard; in no instance was lard detected. One sample of American cheese (No. 1413) was a highly colored skim cheese, containing but a trace of fat; the odor of this sample was extremely unpleasant. The price of this food was six cents per pound.

Butter.

I received 49 samples of butter of different grades and prices. Several of this number proved to be oleomargarine, and one was found to contain a considerable amount of lard. The highest percentage of water found in any sample was 12.16. The percentages of insoluble fatty acids found in the pure fat of each sample will be found in the table below.

Inspector's Number.	Price per Pound.	Per cent. Insol. Fatty Acids.	Remarks.
233*a*, ...	–	89.43	
274*a*, ...	$0.38	95 95	Spurious.
275*a*, ...	.35	93.83	Spurious.
276*a*, ...	.35	89.38	
277*a*, ...	.32	88.04	
278*a*, ...	.28	88.34	
279*a*, ...	.35	86.55	Sample contained 12.16 per cent. water.
280*a*, ...	.28	87.43	
281*a*, ...	.35	88.44	
282*a*, ...	.35	88.57	
283*a*, ...	.25	88.92	
285*a*, ...	.25	95 42	Contained consid. lard.
286*a*, ...	.25	88.89	
288*a*, ...	.40	88.76	
289*a*, ...	.30	88.81	
290*a*, ...	.37	89.38	
291*a*, ...	.36	89.60	
292*a*, ...	.30	88.79	
293*a*, ...	.38	88.31	
294*a*, ...	.36	88.37	
295*a*, ...	.36	88.71	

Inspector's Number.	Price per Pound.	Per Cent. Insol. Fatty Acids.	Remarks.
296*a*,	.35	87.47	
297*a*,	.35	89.41	
321*a*,	.36	88.09	
322*a*,	.28	89.17	
323*a*,	.34	88.32	
324*a*,	.34	87.19	
325*a*,	.34	86.41	
326*a*,	.38	87.69	
327*a*,	.30	88.23	
482,	.22	90.46	Spurious.
483,	–	92.19	Spurious.
484,	–	87.42	
485,	.25	91.30	Spurious.
512,	.28	94.14	Spurious.
595,	.30	89.00	
596,	.25	94.06	Spurious.
597,	.25	87.63	
616,	.25	93.02	Spurious.
617,	.20	92.62	Spurious.
1245,	–	87.83	
1246,	–	88.13	
1251,	–	86.29	
1289,	–	87.45	
1290,	–	92.82	Spurious.
1292,	–	87.66	
1294,	–	85.63	
1345,	–	94.33	Spurious.
1911,	–	94.24	Spurious.

The highest limit of insoluble fatty acids in genuine butter fat — 90 per cent. — has been taken as the dividing line between the genuine and the artificial product. Since the samples of real butter which reach this limit are comparatively rare, and since many specimens of imitation butter will fall below the 90 per cent., it is probable that more or less of the samples in the table above, which come very near the line, might be justly designated as spurious.

TEA.

I received 24 samples of tea, in none of which was any adulteration detected. Careful examination of the leaves revealed nothing foreign. The highest percentage of ash was 6.85, and the lowest soluble ash was 2.40, which figures would not indicate any very extensive admixture of tea dust or exhausted leaves.

INSPECTOR'S NUMBER.	Per cent. Soluble Ash.	Per cent. Insol. Ash.	Per cent. Total Ash.
1002,	3.51	2.41	5.92
1003,	2.81	3 26	6.07
1004,	2.71	2.98	5 69
1005,	3.05	3.77	6.82
1010,	3.05	3.07	6.12
1011,	2.56	3 77	6.33
1019,	2.68	4.09	6.77
1020,	2.64	3.84	6.48
1032,	2.92	3.24	6.16
1033,	3.24	2.61	5 85
1034,	2.98	3.04	6.02
1035,	2.98	2.37	5.35
1038,	3.15	2.31	5.46
1039,	2.56	4.15	6.71
1040,	3 04	3.13	6.17
1041,	3.26	2.69	5 95
1044,	3.12	2.52	5.64
1045,	2 45	4 25	6.70
1052,	3.12	3.20	6.32
1056,	2.40	3.70	6.10
1057,	2.73	3.56	6.29
1077,	3 19	2.66	5.85
1106,	3.00	3.22	6.22
1107,	3.40	2.53	5.93

COFFEE.

Eighteen samples of coffee, chiefly raw and unground, were examined for foreign coloring matters, but in no case was anything abnormal detected. One sample of very finely ground coffee was found to be pure.

CANDIES.

Twenty specimens of cheap colored candies were examined with special reference to poisonous colors, terra alba, and glucose. One sample (No. 1373) contained a very small amount of chromate of lead; in no case was terra alba detected. Most of the lot were composed chiefly of glucose, and nearly all contained more or less flour. One sample of so called "Rock and Rye Drops" (No. 347*a*), consisted of glucose and flour, flavored with fusel oil. A single piece contained enough fusel oil to cause quite unpleasant sensations when eaten.

HONEY.

Of nine samples of honey received, but two — and these were in the comb — were genuine. Numbers 1979, 2199, 2201, 2265, 2267, 2301, and 2303 were what is known as strained honey and sold in pots and tumblers. None of these were pure, all containing glucose syrup in varying amounts; one sample appeared to be wholly glucose.

SUGAR.

But five samples of this important food were submitted for examination; three were white, and two brown. The percentages of invert sugar in the latter were 6.25 and 8.33. Only one sample out of the five examined could be in any way deemed adulterated; this was a white sugar which contained a small amount of ultramarine, which is a substance not uncommonly used to improve the appearance of white sugars which are "off color."

CANNED VEGETABLES.

Eleven samples of canned foods were examined for metallic contaminations; in four of the samples zinc was present in traces, and in two others traces of tin were found.

Inspector's Number.	Nature of Food.	Results.
1903, ...	Tomatoes, . .	Traces of tin.
1905, ...	Corn, . . .	No metallic contamination.
1907, ...	Pease, . . .	Traces of zinc.
2305, ...	Lima beans, . .	No metallic contamination.
2307, ...	Tomatoes, . .	Traces of tin.
2309, ...	Pease, . . .	Traces of zinc.
2321, ...	String beans, .	No metallic contamination.
2323, ...	Tomatoes, . .	Traces of zinc.
2335, ...	Tomatoes, . .	Traces of zinc.
2337, ...	Lobster, . .	No metallic contamination.
2339, ...	Blueberries, . .	No metallic contamination.

In each case the contents of the can were removed as soon as the can was opened so as to give no opportunity for action on the can after the admission of air.

Meat Extracts.

Five different preparations of meat extracts were examined with results as given below. These preparations are not foods in the ordinary acceptation of the term, but belong rather to the class of stimulants, and their value is chiefly in the sick-room. They are not subject to adulteration.

No. 59a. Delacre's Extract of Beef.

Water, ...	20.26	per cent.
Organic matter, ...	60.50	"
Alcoholic extract, ...	56.13	"
Ash, ...	19.24	"

No. 60a. Johnston's Fluid Beef.

Water, ...	49.54	per cent.
Organic matter, ...	47.16	"
Alcoholic extract, ...	20.13	"
Ash, ...	3.30	"

No. 61a. Valentine's Meat Juice.

Water, ...	66.29	per cent
Organic matter, ...	22.62	"
Alcoholic extract, ...	28.67	"
Ash, ...	11.09	"

No. 64a. Murdock's Liquid Food.

Water,	83.13	per cent.
Organic matter,	16.45	"
Alcoholic extract,	1.97	"
Albumen,	14.10	"
Ash,	0.42	"

No. 306a. Liebig's Extract.

Water,	24.10	per cent.
Organic matter,	52.16	"
Alcoholic extract,	54.87	"
Ash,	23.74	"

Numbers 59*a* and 306*a* are true meat extracts; number 64*a* appears to be not an extract, but rather a preparation of beef or other blood.

Pickles.

Four samples of American bottled pickles were found to be of very good quality. There was no evidence of the use of copper or alum in their preparation.

Baking Powders and Cream of Tartar.

These two classes of preparations, and particularly the latter, are subject to very extensive adulteration.

The competition existing among the manufacturers of the better brands of baking powders insures purity to a considerable extent; but the numerous cheap articles, the sale of which is promoted by the presentation of cups and saucers, tin spoons and other table ware, chromos, etc., etc., are always suspicious and should be avoided on general principles. The cheaper baking powders are more likely to contain alum than cream of tartar; the latter substance is the acid salt which is most commonly used in the manufacture of the better brands. I examined five of the cheaper brands and found one to be composed of cream of tartar and bicarbonate of soda, one of the latter substance with acid phosphate, and three of alum and bicarbonate of soda. The latter were condemned as unwholesome, since the weight of evidence on the subject is to the effect that alum is not a proper substance to be used in the baking of bread.

Cream of tartar is more subject to adulteration than the baking powders, since it is most often sold in bulk and

unmarked. The proportion of adulteration is somewhat greater in the western part of the State than in the eastern counties, a fact undoubtedly due to the greater convenience of obtaining supplies of New York and Connecticut wholesalers, who cannot be directly reached by our state laws.

I examined 232 samples of cream of tartar, and passed as unadulterated all that contained at least 90 of bitartrate of potassium. There were 155 of such and 77 that fell below.

Number of samples containing	98%,	1
" " "	between 97% and 98%,	7
" " "	" 96% " 97%,	12
" " "	" 95% " 96%,	34
" " "	" 94% " 95%,	45
" " "	" 93% " 94%,	14
" " "	" 92% " 93%,	19
" " "	" 91% " 92%,	13
" " "	" 90% " 91%,	10
Total number containing over 90%,		155

Number of samples containing	between 80% and 90%,	11
" " "	" 70% " 80%,	6
" " "	" 60% " 70%,	17
" " "	" 50% " 60%,	10
" " "	" 40% " 50%,	13
" " "	" 30% " 40%,	13
" " "	" 20% " 30%,	1
" " "	" 10% " 20%,	6
" " "	less than 10% (9.40%),	1
Total number of samples containing less than 90%,		77
Total number of samples examined,		232

The adulterants most commonly used were terra alba, flour, and acid phosphate.

The adulterated samples bore the numbers — 27, 35, 66, 75, 78, 84, 90, 117, 118, 130, 142, 153, 174, 180, 189, 196, 199, 200, 204, 214, 223, 252, 268, 291, 299, 381, 384, 406, 421, 427, 430, 454, 466, 470, 480, 491, 493, 506, 507, 512, 513, 516, 519, 520, 524, 525, 531, 534, 539, 541, 559, 563, 564, 570, 572, 583, 584, 585, 590, 592, 595, 1023, 1099, 1293, 1327, 1329, 1354, 1367, 1372, 1375, 1387, 1410, 1687, 2043, 2069, 2075, 2101, and 2331.

Mustard.

I received 88 samples of mustard, many of which were marked as compounds, some plainly, but as is the case with all substances subject to compounding, most of them were marked with evident intent to deceive, while perhaps conforming to the law.

The following 20 were compounds: — Nos. 2, 10, 255, 349, 377, 1009, 1016, 1028, 1093, 1160, 1170, 1175, 1225, 1244, 1287, 1342, 1365, 1366, 1374, and 1394.

The following 31 were genuine: — Nos. 3, 4, 9, 108, 134, 282, 320, 376, 398, 402, 458, 487, 522, 540, 580, 1014, 1027, 1042, 1046, 1047, 1048, 1054, 1080, 1082, 1112, 1295, 1325, 1340, 1390, 1411, and 1583.

The balance, 37 in number, were found to be adulterated. The adulterants employed were chiefly flour and turmeric, with sometimes a little cayenne. One brand, which was formerly to be found in considerable amounts throughout the State, has been frequently found so weak that a teaspoonful of the dry powder taken into the mouth, masticated and swallowed, would produce no very unpleasant sensation. Most of the adulterated samples which came in tins were "warranted for purity, pungency, and flavor."

The adulterated samples bore the numbers 22, 23, 28, 29, 33, 36, 83, 86, 119, 128, 133, 139, 289, 325, 386, 418, 422, 428, 441, 1015, 1029, 1122, 1124, 1183, 1232, 1250, 1288, 1323, 1324, 1326, 1341, 1386, 1404, 1412, 2059, 2095 and 2105.

Cloves.

I received seventy-six specimens of ground cloves, only fifteen of which could be considered as unadulterated. The others were in almost every case deprived of most of the oil of cloves which they naturally contain, and mixed with ground clove stems, allspice, burnt shells, or other cheap substance. One sample contained a very large amount of wheat flour.

Nos. 71 and 283 were marked compound. The good and passable samples were numbers 391, 414, 472, 555, 1144, 1179, 1203, 1209, 1215, 1227, 1347, 1352, 1759 and 1771. Samples which contained but a small percentage of stems were considered as fairly good.

The following samples were adulterated: Numbers 6, 45, 54, 57, 62, 80, 122, 131, 137, 148, 159, 176, 187, 253, 269, 274, 287, 296, 302, 306, 310, 314, 318, 324, 339, 347, 352, 361, 364, 372, 385, 403, 407, 411, 438, 447, 450, 465, 467, 482, 484, 492, 1109, 1118, 1125, 1130, 1136, 1151, 1153, 1162, 1167, 1172, 1188, 1200, 1221, 1234, 1243, 1749, and 1785.

Cassia.

Seventy-five samples of cassia and cinnamon were received and examined. One sample (No. 34) was marked compound, twenty-six were adulterated, and the remaining forty-eight were genuine. The commonest admixtures were ground shells and cracker.

The following were the inspectors' numbers on the pure samples: 302*a*, 308*a*, 313*a*, 316*a*, 318*a*, 328*a*, 329*a*, 50, 74, 79, 89, 114, 126, 141, 154, 156, 158, 181, 192, 258, 301, 340, 344, 353, 359, 374, 389, 412, 415, 417, 425, 431, 439, 468, 481, 568, 1129, 1135, 1142, 1154, 1174, 1181, 1186, 1205, 1236, 1241, 1380, 1769 and 1781.

The following were the adulterated samples: — Numbers 209*a*, 5, 46, 59, 64, 103, 121, 316, 382, 393, 456, 489, 1148, 1163, 1168, 1199, 1211, 1217, 1223, 1229, 1350, 1355, 1370, 1376, 1747 and 1757.

Ginger.

This substance is much less subject to adulteration than most of the condiments and spices. Of seventy-two samples received, all but seventeen were pure. Of the latter, numbers 319*a*, 254, 300, 307, 436, 1105 and 1196 were colored samples, containing considerable excess of turmeric; number 300 contained clove stems in addition to the turmeric; numbers 395 and 1123 contained wheat flour; numbers 312*a*, 348, 432, 462, 569, 586, 1149, 1214 and 2047 were adulterated with corn meal.

Numbers 300*a*, 303*a*, 309*a*, 317*a*, 265, 271, 281, 303, 311, 315, 319, 328, 342, 354, 358, 366, 375, 399, 408, 449, 455, 474, 478, 486, 490, 554, 1108, 1116, 1134, 1156, 1161, 1166, 1171, 1178, 1189, 1202, 1208, 1220, 1226, 1233, 1242, 1348, 1353, 1383, 1751, 1761, 1775, 1787, 2055, 2065, 2077, 2083, 2091 and 2103 were genuine.

ALLSPICE.

Like the preceding this substance is, on account of its cheapness, not subject to very extensive adulteration. Eight samples out of thirty-eight were somewhat adulterated. The substances detected were mustard hulls, ground shells, clove stems and ground cracker. Numbers 301*a*, 32, 52, 55, 257, 272, 357 and 419 were adulterated. Numbers 304*a*, 310*a*, 315*a*, 320*a*, 40, 43, 58, 63, 76, 88, 107, 113, 116, 125, 132, 136, 137, 275, 341, 346, 360, 365, 373, 440, 443, 464, 469, 473, 555 and 558 were genuine.

GROUND MACE.

I received eighteen samples of mace; one-half of them were adulterated with flour or corn meal. Numbers 51, 263, 314, 1212, 1230, 1237, 1685, 2085 and 2093 were genuine. Numbers 1201, 1206, 1218, 1605, 1611, 2049, 2057, 2067 and 2071 were adulterated.

BLACK PEPPER.

Twenty-eight samples of black pepper were received. Three of the number were marked as compounds—73, 573 and 1344; six were genuine — numbers 152, 259, 304, 557, 1187 and 1385. Numbers 39, 106, 123, 140, 270, 312, 326, 345, 362, 367, 451, 460, 1204, 1222, 1228, 1235, 1240, 1351 and 1406 were adulterated. The substances most commonly used as adulterants of this substance are ground cracker, mustard hulls, pepper dirt, powdered charcoal, etc.

WHITE PEPPER.

But twenty-one samples of this substance out of sixty received proved to be genuine. The greater part of the balance were more or less made up of ground cracker or wheat flour, which are by far the most common adulterants of pepper. Other adulterants detected were corn and rice, buckwheat, and a substance which could not be identified.

The genuine samples were numbered respectively 305*a*, 85, 110, 124, 264, 308, 9*a*, 10*a*, 1110, 1119, 1121, 1155, 1164, 1173, 1180, 1379, 1388, 1601, 1745, 2045, 2081, 2089.

The adulterated specimens bore the numbers 11, 30, 48, 65, 67, 151, 321, 397, 461, 463, 1104, 1128, 1133, 1143, 1150, 1169, 1197, 1201, 1216, 1346, 1371, 1392, 1396, 1399, 1402, 1683, 1689, 1693, 1697, 1755, 1767, 1779, 1859, 2053, 2063, 2073, 2311 and 2315.

Flavoring Extracts.

I received fifteen samples of flavoring extracts, mainly essence of lemon, which were found, with one exception, to be pure. This exception was a bottle of strawberry essence which was found to be an aniline colored fluid flavored with compound ethers. It could not be recommended for the purposes for which it was intended.

Miscellaneous.

I received in addition the following eight articles:

1. Sample of whiskey of a blackish color and with a strong odor of fusel oil. It was sweetish to the taste, though acid in reaction. The volume per cent. of alcohol was 39.5; the residue on evaporation amounted to 0.185 per cent. and contained considerable caramel and a trace of iron. The sample was of very poor quality and was doubtless a manufactured article.
2. Sample of cider jelly; spurious.
3. Diabetic biscuit warranted to contain no starch. This sample contained little else than the substance alleged to be absent.
4. A sample of yellow Vermicelli was examined for poisonous coloring matter and found to be free.
5. One sample of cayenne pepper was found to be pure.
6. One bottle of "celery salt" was found to be as represented.
7. A package of so-called Buttered Flour proved to be wheat flour containing a small percentage of butter or other fat.
8. A bottle of Horseradish was examined and found to be about equal parts of horseradish and turnip.

Respectfully submitted.

EDWARD S. WOOD, M. D.

REPORTS OF THE ANALYSTS OF MILK.

REPORTS OF THE ANALYSTS OF MILK.

Boston, Mass., April, 1885.

Dr. S. W. Abbott, *Health Officer*,
State House, Boston.

Dear Sir: — I have the honor to submit my report as Milk Analyst for Eastern Massachusetts for the year ending March 31st, 1885.

Respectfully,

CHARLES HARRINGTON, M. D.

DR. HARRINGTON'S REPORT.

During the year just ended I have received from the inspectors of the board, and from other sources, 1,759 samples of milk, which number includes samples from all of the cities and many of the towns of Eastern Massachusetts. They have been arranged in classes, according to their respective sources, to wit: —

A. Samples from shops.
B. Samples from wagons.
C. Samples from producers (direct).
D. Samples from unknown sources.
E. Samples of known purity.

Among such a number, taken in most cases at random, there must necessarily be very many which, on inspection alone, are evidently pure, and which, on analysis, would

yield figures above the standard fixed by law. The employment of the lactodensimeter, together with the Feser lactoscope, will, after a little practice, enable one to separate the good from the indifferent and poor samples, and in this way the good samples may, unless there be some reason for a full analysis, — such, for instance, as unusual richness, averages, etc., etc., — be passed on inspection. More than half of the samples submitted to me were good samples, and of the whole number, 569 were passed as above, leaving 1,190 which were subjected to analysis. Of these latter there were 391 which were above, and 799 which were below, the statute standard.

Considering as above the standard the 569 samples which were passed on inspection, we have 960 above and 799 below, which is a very decided improvement over the milk supply of a year ago. A large proportion of those below the standard were not what would be considered as of very inferior quality; nearly one-half of those below the standard of 13% of solids were above 12%, which fact of itself is evidence of a great improvement in the general supply.

The respective sources of the samples, together with the figures obtained by analysis, are given below: —

Boston.

It is but fair to the milk dealers and others interested in the milk supply of this city to state that the greater part of the samples obtained here were from persons who were suspected of dealing in adulterated milk, and hence they may not be taken as a criterion of the whole supply.

	Class A.	Class B.	Total.
Samples received, ...	44	25	69
Passed on inspection, ...	5	10	15
Samples analyzed, ...	*39	15	54
Below the standard, ...	34	10	44
Above standard, including samples passed,	*10	15	25

* Including two samples of cream and three of skim milk (sold as such).

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
	3.80	9.03	12.83	87.17	–
2985, ...	2.91	9.58	12.49	87.51	–
296, ...	2.80	9.46	12.26	87.74	–
	3.20	9.05	12.25	87.75	–
	3.70	8.34	12.04	87.96	–
	3.30	8.70	12.00	88.00	–
	3.00	8.90	11.90	88.10	–
3033, ...	3.16	8.67	11.83	88.17	–
2979, ...	2.77	8.97	11.74	88.26	0.51
	3.25	8.43	11.68	88.32	–
	2.80	8.84	11.64	88.36	–
	2.85	8.66	11.51	88.49	–
2989, ...	2.80	8.68	11.48	88.52	–
	2.60	8.86	11.46	88.54	–
2977, ...	2.99	8.45	11.44	88.56	0.54
2783, ...	2.43	8.97	11.40	88.60	–
1570, ...	1.57	9.75	11.32	88.68	0.68
3035, ...	1.77	9.48	11.25	88.75	–
	2.87	8.37	11.24	88.76	–
	3.35	7.82	11.17	88.83	–
2991, ...	2.07	9.00	11.07	88.93	–
	2.77	8.26	11.03	88.97	–
2999, ...	2.86	8.13	10.99	89.01	–
	2.62	8.03	10.65	89.35	–
	3.05	7.48	10.53	89.47	–
	3.10	7.37	10.47	89.53	–
2987, ...	2.43	7.99	10.42	89.58	–
	2.05	7.94	9.99	90.01	–
	2.30	7.54	9.84	90.16	–
3001, ...	0.24	9.44	9.68	90.32	
	2.05	7.43	9.48	90.52	–
	2.37	7.00	9.37	90.63	–
	2.37	6.44	8.81	91.19	–
2993, ...	1.55	6.81	8.36	91.64	0.48
500,*	14.14	8.81	22.95	77.05	–

* Cream (sold as such).

Class A — Concluded.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
532,*	44.00	6.57	50.57	49.43	0.32
498,†	0.03	10.06	10.09	89.91	-
3005,†	0 04	9.38	9.42	90.58	-
3003,‡	0.37	9.26	9.63	90.37	0.60

Class B.

	11 78	7.29	19.07	80.93	-
	4 32	9.66	13.98	86.02	0.59
3015, ...	3.64	9 63	13.27	86.73	-
	3.95	9.32	13.27	86.73	-
	4.05	9.00	13.05	86.95	-
	3.10	9.07	12.17	87.83	-
3017, ...	3.26	8.75	12.01	87.99	-
	2.85	8.96	11.81	88.19	-
	3.30	8.36	11.66	88.34	-
	2.85	8.78	11.63	88.37	-
	3.00	8.35	11.35	88.65	-
	2.75	8.53	11.28	88.72	-
	3.05	8.09	11.14	88.86	-
	3.35	7 44	10.79	89.21	-
	2.60	8.08	10 68	89.32	-

Summary.

	A.	B.
Samples analyzed, ...	39§	15
Below standard, ...	34	10
Above standard, ...	5§	5

Cambridge.

	Class A.	Class B.	Total.
Samples received, ...	70	87	157
Passed on inspection, ...	11	22	33
Samples analyzed, ...	59	65	124
Below standard, ...	50	42	92
Above standard, including samples passed,	20	45	65

* Cream (sold as such). † Skim milk (sold as such). ‡ Butter milk (sold as such).
§ Including 2 creams; 2 skim milks; 1 butter milk.

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
247, ...	4.78	10.04	14.82	85.18	–
2253, ...	5.15	9.63	14.78	85.22	–
2257, ...	5.28	9.21	14.49	85.51	–
	4.15	10.10	14.25	85.75	–
251, ...	3.41	10.19	13.60	86.40	–
1573, ...	4.28	9.11	13.39	86.61	–
2249, ...	3.81	9.44	13.25	86.75	–
2255, ...	2.89	10.19	13.08	86 92	–
1541, ...	3.27	9.73	13.00	87.00	–
1544, ...	2.79	10.14	12.93	87.07	–
2763, ...	2.87	10.05	12.92	87.08	–
2261, ...	3.05	9.84	12.89	87.11	–
	3.75	8.99	12.74	87.26	–
	3.93	8.79	12.72	87.28	–
	3.10	9.55	12.65	87 35	–
1540, ...	3.32	9.23	12.55	87.45	–
	3.56	8.93	12.49	87.51	–
246, ...	2.26	10.15	12.41	87.59	–
370, ...	3.05	9.18	12 23	87.77	–
2245, ...	2.92	9.26	12.18	87 82	–
	3.38	8 78	12.16	87.84	–
306, ...	2.49	9 65	12.14	87 86	–
	3.58	8.41	11.99	88.01	–
2263, ...	3.94	7 93	11.87	88.13	–
1539, ...	2.54	9.30	11.84	88.16	–
2259, ...	2.28	9.41	11.69	88.31	–
1522, ...	3.01	8.48	11.49	88 51	0.56
209, ...	1.92	9.54	11 46	88.54	–
1542, ...	2.45	8 99	11.44	88 56	–
1577, ...	3.02	8.41	11 43	88 57	–
307, ...	3.03	8 39	11.42	88 58	–
304, ...	2 61	8.72	11.33	88 67	–
	3.20	8.09	11 29	87.71	–
205, ...	1.95	9 31	11 26	88.74	–
1499, ...	2.38	8.86	11.24	88.76	–
1543, ...	0.79	10 41	11.20	88 80	–
207, ...	2 04	9.12	11.16	88 84	–

Class A — Concluded.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
	2.75	8.36	11.11	88 89	-
249,	1.44	9.66	11.10	88.90	0.72
1524,	3.17	7 93	11.10	88 90	-
2785,	1.81	9 21	11.02	88.98	-
214,	2.54	8 46	11.00	89.00	-
2251,	2.92	7.92	10.84	89 16	-
206,	1.74	8.94	10.68	89.32	-
303,	1.08	9.38	10.46	89 54	-
	2.12	8.22	10 34	89.66	-
	2 60	7.73	10.33	89.67	-
2777,	1.41	8.84	10.25	89 75	-
	2 90	7.31	10.21	89.79	-
241,	1 20	9.00	10.20	89.80	0 59
210,	2.14	8.04	10 18	89.82	-
208,	1.42	8.53	9 95	90.05	-
305,	0.26	9.65	9 91	90 09	-
1575,	1.56	8.30	9.86	90 14	-
211,	2.20	7.56	9 76	90.24	-
213,	1.01	8.67	9.68	90.32	-
245,	0.74	8 89	9.63	90 37	-
204,	1.79	7 34	9.13	90 87	-
202,	3.48	5.49	8.97	91.03	-

Class B.

377,*	16.45	8 96	25.41*	74.59	-
1537,*	14.49	9 17	23.66*	76 34	-
1472,	4.43	10.44	14.87	85.13	-
605,	4.13	10.52	14 65	85.35	-
33,	4.29	10 26	14.55	85 45	0.67
602,	4.74	9.75	14.49	85 51	-
1477,	4.73	9.64	14.37	85.63	-
38,	3.58	10.49	14.07	85.93	0.68
601,	4.02	9.93	13.95	86.05	-
1480,	4.04	9.75	13.79	86 21	-
1574,	4 25	9.53	13.78	86 22	-

* Sold as milk.

Class B — Continued.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
599, ...	3.96	9.79	13.75	86.25	–
373, ...	–	–	13.71	86.29	–
1520, ...	3.68	10.02	13.70	86.30	–
600, ...	4.30	9.31	13.61	86.39	–
2759, ...	3.43	10.17	13 60	86.40	–
1519, ...	3.92	9.65	13.57	86.43	–
604, ...	3.16	10.39	13.55	86.45	–
1481, ...	3.55	9.83	13.38	86.62	–
1475, ...	4.00	9.29	13.29	86.71	–
2783, ...	3.37	9.83	13.20	86.80	–
2761, ...	2.69	10.46	13.15	86.85	–
1478, ...	3.32	9.76	13.08	86.92	–
28, ...	2.82	10.16	12.98	87.02	0.69
1479, ...	3.10	9.79	12 89	87.11	–
598, ...	3.21	9.59	12.80	87.20	–
1483, ...	3.11	9 66	12.77	87.23	–
32, ...	3.35	9.38	12.73	87.27	0.63
1538, ...	2.96	9.64	12.60	87.40	–
1473, ...	3.57	8.97	12.54	87.46	–
381, ...	2.95	9 52	12 47	87.53	–
378, ...	2.40	9 89	12.29	87.71	–
365, ...	2.26	10.01	12.27	87.73	–
2247, ...	3.47	8.75	12.22	87.78	–
1500, ...	2.95	9.24	12.19	87.81	–
29, ...	2.78	9.22	12.00	88.00	0.65
30, ...	2.56	9.39	11.95	88.05	0.58
1521, ...	3.79	8.10	11.89	88.11	–
34, ...	3.27	8.59	11.86	88.14	0.63
1493, ...	2.77	9.09	11.86	88 14	–
368, ...	1.62	10.23	11.85	88.15	–
31, ...	2.94	8.89	11.83	88.17	0.62
1474, ...	2.54	9.29	11.83	88.17	–
1523, ...	1.88	9.92	11.80	88.20	0.69
1476, ...	1.60	10.19	11.79	88.21	–
1525, ...	3.33	8.38	11.71	88.29	–
380, ...	1.85	9.82	11.67	88.33	–
603, ...	3.72	7.88	11.60	88.40	–

Class B — Concluded.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1572, ...	2.10	9.48	11.58	88.42	0.55
375, ...	1.56	9.99	11.55	88.45	-
25, ...	2.36	9.15	11.51	88 49	0.65
26, ...	2 63	8.78	11.41	88.59	0.61
27, ...	2.34	9.03	11.37	88.63	0.59
24, ...	2.13	9.19	11.32	88.68	0.68
1495, ...	1.89	9.17	11.06	88.94	-
36, ...	1.90	8.95	10.85	89.15	0.62
1494, ...	1.87	8.95	10.82	89.18	0.49
1491, ...	2.61	7.99	10.60	89.40	0.50
376, ...	2 49	8.09	10.58	89.42	-
35, ...	1.01	9.53	10.54	89.46	0.77
2779, ...	2.04	8.04	10.08	89.92	0.45
379, ...	0.73	9.19	9.92	90.08	0.60
1502, ...	2.19	7.42	9.61	90.39	-
1471, ...	2.15	7.29	9.44	90.56	-
1505, ...	1.71	6.82	8.53	91.47	-

Worcester.

	Class A.	Class B.	Total.
Samples received, ...	12	69	81
Passed on inspection, ...	3	40	43
Samples analyzed, ...	9	29	38
Below standard, ...	5	22	27
Above standard, including samples passed,	7	47	54

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1249, ...	4.02	9.97	13.99	86.01	-
1154, ...	4.47	9.02	13.49	86.51	-
1246, ...	3.19	10 05	13.24	86.76	-
1156, ...	2.96	10.06	13 02	86.98	-
1153, ...	3.26	9.45	12.71	87.29	-
1152, ...	2.02	9.48	11.50	88.50	-
1245, ...	2.49	8.62	11.11	88.89	0.64
1243, ...	2.12	8.94	11.06	88.94	-
1155, ...	2 02	8.37	10.39	89.61	-

Class B.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1444,	5.20	9.62	14.82	85.18	–
1441,	4.67	10.13	14.80	85.20	–
1561,	3.89	9.91	13.80	86.20	–
1560,	3.33	10.04	13.37	86.63	–
1564,	3.32	9.75	13.07	86.93	–
1554,	3.16	9.85	13.01	86.99	–
1440,	3.54	9.47	13.01	86.99	–
1437,	3.85	9.02	12.87	87.13	0.58
1157,	3.40	9.39	12.79	87.21	–
1439,	3.79	8.94	12.73	87.27	–
1145,	2.90	9.79	12.69	87.31	–
1556,	3.19	9.42	12.61	87.39	–
1446,	3.48	9.11	12.59	87.41	–
1144,	2.62	9.83	12.45	87.55	–
1435,	2.67	9.77	12.44	87.56	–
1151,	3.19	9.12	12.31	87.69	–
1012,	2.88	9.28	12.16	87.84	–
1158,	2.59	9.46	12.05	87.95	–
1315,	2.56	9.48	12.04	87.96	0.70
1148,	2.81	8.98	11.79	88.21	–
1146,	2.72	8.97	11.69	88.31	–
1445,	3.02	8.51	11.53	88.47	0.59
1008,	2.24	9.22	11.46	88.54	–
1436,	1.70	9.76	11.46	88.54	–
1127,	2.46	8.81	11.27	88.73	–
1240,	2.62	8.62	11.24	88.76	–
1443,	0.32	10.90	11.22	88.78	–
1236,	2.79	8.38	11.17	88.83	0.51
1321,	2.02	7.82	9.84	90.16	0.49

Fall River.

	Class A.	Class B.	Total.
Samples received,	40	61	101
Passed on inspection,	6	27	33
Samples analyzed,	34	34	68
Below standard,	23	17	40
Above standard, including samples passed,	17	44	61

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1297, ...	6.15	8.94	15.09	84.91	–
1459, ...	4 48	10 40	14.88	85 12	–
1300, ...	4.41	9.59	14.00	86.00	–
1457, ...	3 81	10.07	13.88	86.12	–
1725, ...	3.84	9.99	13.83	86.17	–
3159, ...	3.67	10.02	13.69	86.31	–
1298, ...	3.83	9.61	13.44	86.56	–
3161, ...	3.85	9.59	13.44	86.56	–
1458, ...	4.14	9.28	13.42	86.58	–
1701, ...	3.52	9.88	13.40	86.60	–
3177, ...	3.31	9.76	13.07	86.93	–
1259, ...	3.51	9.25	12.76	87.24	–
3175, ...	3 16	9.20	12 36	87.64	–
1452, ...	2.39	9 67	12.06	87.94	–
1184, ...	2 30	9.61	11.91	88.09	–
1264, ...	2.61	9 12	11.73	88.27	0.60
1302, ...	3.07	8.66	11.73	88.27	–
1189, ...	3.71	7.99	11.70	88.30	–
1262, ...	2.43	9.26	11.69	88.31	–
1296, ...	2.27	9.22	11 49	88.51	–
1261, ...	1.89	9.54	11.43	88.57	0.60
1265, ...	1 57	9.84	11.41	88.59	–
1301, ...	2.95	8.37	11.32	88.68	–
1260, ...	1.17	10.00	11.17	88.83	0.66
1251, ...	2.41	8.57	10.98	89.02	0.58
1186, ...	2.47	8.48	10.95	89 05	–
1185, ...	2.27	8.31	10.58	89.42	–
3173, ...	2.09	8 47	10 56	89.44	–
1451, ...	2.88	7.65	10.53	89.47	–
1192, ...	2.10	8.31	10.41	89.59	–
1263, ...	0.72	9.54	10 26	89.74	–
1188, ...	2.97	7.17	10.14	89.86	–
1190, ...	3 13	6 99	10.12	89.88	–
1187, ...	2.36	7.50	9.86	90.14	–

Class B.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1449, ...	6.29	10.04	16.33	83.67	-
3165, ...	4.27	10.19	14.46	85.54	-
3157, ...	3 77	10 53	14.30	85.70	-
3167, ...	4 08	10.22	14.30	85.70	-
3153, ...	4.07	10.21	14.28	85.72	-
3151, ...	4 19	10.04	14.23	85.77	-
3171, ...	3 96	10.27	14.23	85.77	-
3155, ...	4.64	9 39	14.03	85.97	-
3169, ...	4.11	9.86	13.97	86.03	-
1703, ...	4.13	9.76	13.89	86.11	
1717, ...	3.67	10.15	13.82	86 18	
1448, ...	4.15	9.62	13 77	86.23	-
1713, ...	3.93	9.63	13.56	86.44	-
1699, ...	4.46	8.94	13.40	86.60	-
1293, ...	4.07	9.03	13.10	86.90	-
1295, ...	3.62	9.40	13.02	86.98	-
1180, ...	2.99	10.01	13 00	87.00	-
1450, ...	2.95	9 96	12.91	87.09	-
1294, ...	3.69	9 20	12.89	87.11	-
1705, ...	3.54	9.29	12.83	97.17	-
3163, ...	3.17	9 44	12.61	87.39	-
1044, ...	2.73	9.78	12.51	87.49	-
1715, ...	3.14	9.31	12.45	87.55	-
1043, ...	2.91	9.22	12.13	87.87	-
1051, ...	2.27	9.83	12.10	87.90	-
1182, ...	2.25	9.77	12.02	87.98	-
1709, ...	2.98	8.94	11.92	88.08	-
1047, ...	3.32	8.44	11.76	88 24	-
1179, ...	2.76	8.95	11.71	88 29	-
1054, ...	2.52	9 12	11.64	88.36	-
1040, ...	3.03	8.48	11.51	88.49	-
1250, ...	2 68	8.73	11.41	88.59	0.60
1258, ...	2.85	8.32	11.17	88.83	-
1039, ...	3.03	6.01	9.04	90.96	-

Lynn.

	Class A.	Class B.	Total.
Samples received, ...	69	77	146
Passed on inspection, ...	4	20	24
Samples analyzed, ...	65	57	122
Below standard, ...	54	55	109
Above standard, including samples passed,	15	22	37

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
591, ...	3.79	10.47	14.26	85.74	–
308, ...	4.00	9.86	13.86	86.14	–
390, ...	3.63	9.91	13.54	86 46	–
589, ...	4.16	9.38	13.54	86.46	–
1616, ...	3.80	9.67	13.47	86.53	–
588, ...	3.88	9.55	13.43	86.57	–
314, ...	3.66	9.71	13.37	86.63	–
1610, ...	3.66	9.64	13 30	86.70	–
592, ...	3.17	10.06	13.23	86.77	–
1612, ...	3.71	9.49	13 20	86.80	–
583, ...	3.63	9.53	13.16	86.84	–
1620, ...	3.65	9.32	12.97	87.03	–
1618, ...	3.52	9.30	12.82	87.18	–
1614, ...	3.26	9.55	12.81	87.19	–
585, ...	2.87	9.76	12.63	87.37	–
295, ...	2.70	9.70	12.40	87.60	–
584, ...	3.52	8.86	12.38	87.62	–
586, ...	3.45	8.92	12.37	87.63	–
581, ...	3.44	8.91	12.35	87.65	–
261, ...	3.88	8.46	12.34	87.66	–
292, ...	2.50	9.82	12.32	87.68	–
589, ...	2.67	9.48	12.15	87.85	–
55, ...	3 52	8.59	12 11	87.89	–
258, ...	2.24	9.83	12.07	87 93	–
238, ...	4.25	7.78	12.03	87.97	–
594, ...	1.68	10.26	11.94	88.06	0.64
179, ...	4.52	7.15	11.67	88.33	0.47
176, ...	3.35	8.28	11.63	88.37	–
253, ...	2.56	9.04	11.60	88.40	–
289, ...	3.87	7.65	11.52	88 48	–

Class A — Concluded.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
242, ...	2.45	8.98	11.43	88.57	–
181, ...	1.58	9.72	11 30	88.70	–
321, ...	3.23	7.98	11 21	88 79	–
322, ...	2.06	9.11	11 17	88.83	–
582, ...	2.45	8.70	11.15	88.85	0.60
593, ...	2 66	8.35	11.01	88.99	0.55
293, ...	2.93	8.01	10.94	89.06	0.58
173, ...	2.03	8·88	10.91	89.09	–
59, ...	2.39	8.50	10.89	89.11	–
182, ...	1.89	8.99	10.88	89.12	–
315, ...	2.42	8.29	10.71	89.29	–
259, ...	2.41	8.28	10.69	89.31	–
258, ...	2.24	8.42	10.66	89.34	–
239, ...	2 31	8.18	10.49	89 51	–
309, ...	2.42	8.01	10.43	87.57	–
290, ...	1.75	8.62	10 37	89.63	–
312, ...	2.66	7 63	10.29	89.71	–
254, ...	1.94	8.26	10.20	89.80	–
184, ...	2.62	7.48	10.10	89.90	–
175, ...	2.47	7.61	10.08	89.92	–
183, ...	1.71	8 26	9.97	90.03	–
248, ...	1.87	7.95	9.82	90.18	–
255, ...	1 98	7.78	9 76	90.24	–
177, ...	1.92	7.83	9.75	90.25	–
174, ...	2.18	7.39	9.57	90.43	–
250, ...	2.06	7.50	9 56	90.44	–
185, ...	1.53	7.86	9.39	90.61	–
57, ...	1.81	7.35	9.16	90.84	–
178, ...	2.22	6.92	9.14	90.86	–
256, ...	1.24	7 81	9.05	90.95	–
180, ...	0.62	8 11	8.73	91 27	–
252, ...	1 57	6.91	8.48	91.52	–
260, ...	0.86	7.56	8.42	91.58	–
244, ...	0.67	7.36	8.03	91 97	–
323, ...	1.46	6.37	7.83	92.17	0.49

Class B.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1899,	3.87	10 08	13.95	86.05	–
1887,	3.59	10.27	13 86	86.14	–
1879,	3.48	9.46	12 94	87.06	–
1885,	3.51	9.37	12.88	87.12	–
1624,	2.83	9.95	12.78	87.22	–
289,	3.33	9.28	12 61	87.39	–
65,	3.03	9.55	12 58	87.42	0.72
1622,	3.08	9.46	12.54	87.46	–
327,	2.82	9.65	12 47	87.53	–
328,	2 45	10.01	12.46	87.54	–
339,	2.42	10.00	12 42	87.58	–
1873,	2.70	9.71	12.41	87.59	–
334,	2.78	9.57	12.35	87 65	–
228,	3.44	8.83	12.27	87.73	–
62,	3.03	9.12	12.15	87.85	0.58
1881,	3.04	9.05	12.09	87.91	–
332,	2 33	9.75	12 08	87.92	–
280,	3.25	8.66	11.91	88.09	–
325,	2.46	9.42	11 88	88.12	–
311,	3.20	8.66	11.86	88.14	–
73,	2.50	9.34	11 84	88.16	–
331,	2.64	9.19	11.83	88.17	–
338,	2.67	9.13	11.80	88.20	0.60
53,	3.13	8.65	11.78	88.22	0.56
340,	2.60	9.14	11.74	88.26	–
317,	2.24	9.42	11.66	88.34	–
341,	1.67	9.99	11.66	88.34	–
1891,	2.54	9.07	11.61	88.39	–
75,	2.50	8.92	11.42	88 58	0.61
61,	2.28	9.09	11.37	88.63	0.67
72,	3.17	8.16	11.33	88 67	0.52
56,	2.32	8.74	11 06	88.94	0.62
282,	1.80	9.17	10.97	89 03	–
283,	2.82	8.08	10.90	89.10	–
71,	2.71	8.17	10.88	89.12	0.64
67,	2.75	8.11	10.86	89.14	0 53
326,	2.34	8.45	10 79	89.21	–
60,	2.42	8.36	10.78	89.22	0.63

Class B — Concluded.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
281,	2.80	7.98	10.78	89 22	–
68,	2.56	8.15	10.71	89.29	0 59
284,	2.36	8.35	10.71	89.29	–
342,	2.59	8 11	10.70	89.30	0.55
63,	2 04	8 64	10.68	89.32	0.57
285,	1.75	8.90	10.65	89.35	–
291,	2.75	7.84	10.59	89.41	0.58
346,	2.27	8.28	10.55	89.45	0.60
186,	2.24	8.21	10.45	89.55	–
54,	2.61	7.80	10.41	89 59	0.61
335,	2 21	8.02	10.23	88.77	–
66,	2.11	8.08	10.19	89.81	0.56
58,	2.20	7.97	10.17	89.83	0.61
69,	1.57	8.54	10.11	89 89	0.54
329,	1.90	8.11	10.01	89.99	–
64,	1.12	8 74	9.86	90.14	0.62
70,	1.95	7.75	9.70	90.30	0 58
74,	1.22	8.43	9.65	90.35	0.62
343,	1.65	7.82	9.47	90.53	0.54

Lawrence.

	Class A.	Class B.	Total.
Samples received,	8	72	80
Passed on inspection,	–	29	29
Samples analyzed,	8	43	51
Below standard,	3	17	20
Above standard, including samples passed,	5	55	60

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
5,	2.98	10.76	13.74	86.26	0.75
3,	3.23	10.44	13.67	86.33	0.70
7,	3.95	9.63	13.58	86 42	0 71
6,	3.97	9 59	13.56	86.44	0.67
4,	3.01	10.21	13.22	86.78	0.68
2,	3.78	9.08	12.86	87.14	0.62
8,	3.16	9.61	12.77	87.23	0.69
1,	2.73	9.80	12.53	87.47	0 67

Class B.

Inspector's Number	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
20,	5.39	10.15	15.54	84.46	0.75
477,	4.66	10.22	14 88	85.12	–
127,	4.31	10.13	14.44	85.56	–
15,	4.09	10.32	14.41	85.59	0.71
14,	3.89	10.41	14.30	85 70	0.75
474,	3.98	10.26	14.24	85.76	–
123,	4.66	9.51	14.17	85.83	–
10,	4.48	9.68	14.16	85.84	0.69
481,	4.02	9.99	14.01	85.99	–
11,	3.72	10.12	13.84	86.16	0.72
479,	3.64	10.18	13 82	86.18	–
2278,	3.65	10.12	13.77	86.23	–
672,	4.07	9.65	13.72	86.28	–
670,	3.40	10.30	13.70	86 30	–
122,	2.72	10.87	13.59	86.41	–
117,	3.50	10 08	13.58	86.42	–
480,	3.47	10.00	13 47	86.53	–
12,	3.39	9 93	13.32	86.68	0.72
607,	3.94	9 34	13.28	86.72	–
478,	3.45	9.83	13.28	86.72	–
17,	3.26	10 01	13.27	86.73	0.78
13,	3.62	9.62	13.24	86.76	0.68
677,	3.96	9.26	13.22	86.78	–
2264,	3.49	9.70	13.19	86.81	–
19,	3.41	9.74	13.15	86.85	0.70
475,	3.10	9.94	13.04	86.96	–
676,	3.80	9.08	12.88	87.12	–
118,	2.85	10.01	12.86	87.14	–
119,	2.74	10.01	12.75	87.25	–
115,	3.05	9.69	12.74	87.26	–
128,	2.94	9.79	12.73	87.27	–
476,	2.86	9.86	12.72	87.28	–
126,	3.70	9.01	12.71	87.29	–
121,	2.95	9.64	12.59	87.41	–
125,	2.83	9.59	12.42	87.58	–
606,	2.46	9.73	12.19	87.81	–
18,	3.05	9.08	12.13	87.87	0.68

Class B — Concluded.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
120,	3.03	9.09	12.12	87.88	–
16,	2.97	9.12	12.09	87.91	0.71
124,	2.65	9.28	11.93	88.07	–
9,	2.48	9.27	11.75	88.25	0.72
612,	2.47	8.94	11.41	88.59	–
116,	2.45	8.89	11.34	88.66	–

Lowell.

	Class A.	Class B.	Total.
Samples received,	14	138	152
Passed on inspection,	4	67	71
Samples analyzed,	10	71	81
Below standard,	10	45	55
Above standard, including samples passed,	4	93	97

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
2200,	3.79	9.17	12.96	87.04	–
2198,	3 10	9.71	12.81	87.19	–
2192,	2.87	9.92	12.79	87.21	–
2184,	2.60	10.02	12.62	87.38	–
1968,	2.87	9.66	12.53	87.47	–
2144,	3.00	9.11	12.11	87.89	–
2293,	2.80	8.59	11.39	88.61	–
2194,	1.32	9.78	11 10	88.90	–
2170,	2.04	7.60	9.64	90.36	–
2186,	0.45	7.95	8.40	91.60	–

Class B.

2044,	3.35	10.85	14 20	85.80	–
2050,	3.35	10.71	14.06	85.94	–
1970,	3 90	10.14	14.04	85.96	–
2168,	3.60	9.40	14.00	86.00	–
2172,	4.20	9.60	13.80	86.20	–
2156,	3.60	10.20	13.80	86.20	–

Class B — Continued.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
2048,	3.75	9.97	13.72	86.28	–
2166,	3.41	10.24	13.65	86.35	–
1984,	3.50	10.10	13.60	86.40	–
2160,	4.18	9.39	13.57	86.43	–
40,	3.54	10.10	13.54	86.46	0.67
2171,	3.32	10.16	13.48	86.52	–
2154,	3.40	10.00	13.40	86.60	–
2036,	3.83	9.55	13.38	86.62	–
48,	3.57	9.77	13.34	86.66	0.66
1974,	3.41	9.92	13.33	86.67	–
2164,	3.55	9.75	13.30	86.70	–
2299,	3.36	9.94	13.30	86.70	–
44,	3.27	10.01	13.28	86.72	0.69
2162,	3.35	9.91	13.26	86.74	–
737,	3.47	9.75	13.22	86.78	–
49,	3.88	9.26	13.14	86.86	–
2040,	3.25	9.89	13.14	86.86	–
45,	3.13	9.92	13.05	86.95	0.66
2042,	3.50	9.52	13.02	86.98	–
2052,	3.50	9.50	13.00	87.00	–
736,	3.27	9.68	12.95	87.05	–
2056,	3.49	9.45	12.94	87.06	–
2136,	2.29	10.64	12.93	87.07	–
2176,	2.90	10.01	12.91	87.09	–
2283,	3.26	9.64	12.90	87.10	–
1980,	3.26	9.61	12.87	87.13	–
2046,	3.30	9.56	12.86	87.14	–
448,	3.36	9.48	12.84	87.16	–
1976,	3.45	9.35	12.80	87.20	–
449,	3.41	9.27	12.68	87.32	–
50,	2.35	10.21	12.56	87.44	–
2269,	3.06	9.42	12.48	87.52	–
732,	3.17	9.18	12.35	87.65	–
2034,	3.00	9.25	12.25	87.75	–
2277,	3.30	8.93	12.23	87.77	–
2297,	3.20	8.98	12.18	87.82	–
2148,	2.72	9.45	12.17	87.83	–

Class B — Concluded.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
273, ...	3.18	8.98	12.16	87.84	-
2285, ...	3.42	8.73	12.15	87.85	-
279, ...	3.21	8.93	12.14	87.86	-
51, ...	3.06	8.98	12.04	87.96	0.55
43, ...	2.62	9.41	12.03	87.97	0.67
452, ...	2.73	9.30	12.03	87.97	-
438, ...	3.30	8.72	12.02	87.98	-
2273, ...	3.30	8.72	12.02	87.98	-
2174, ...	2.88	9.06	11.94	88.06	-
2038, ...	3.31	8.59	11.90	88.10	-
436, ...	2.62	9.20	11.82	88.18	-
2289, ...	3.09	8.73	11.82	88.18	-
41, ...	2.62	9.00	11.62	88.38	0.57
447, ...	2.56	9.06	11.62	88.38	-
727, ...	2.97	8.60	11.57	88.43	-
455, ...	2.84	8.62	11.46	88.54	-
39, ...	2.92	8.47	11.39	88.61	0.59
266, ...	2.41	8.91	11.32	88.68	-
434, ...	2.12	9.18	11.30	88.70	-
42, ...	2.17	9.10	11.27	88.73	0.66
445, ...	3.50	7.68	11.18	88.82	-
1988, ...	3.35	7.77	11.12	88.88	-
731, ...	2.76	8.14	10.90	89.10	-
47, ...	2.32	8.23	10.55	89.45	0.51
719, ...	1.83	8.67	10.50	89.50	-
450, ...	2.50	8.58	10.08	89.92	0.48
37, ...	1.94	8.08	10.02	89.98	0.59
46, ...	2.31	7.57	9.88	90.12	0.53

Haverhill.

	Class A.	Class B.	Total.
Samples received, ...	10	22	32
Passed on inspection, ...	3	2	5
Samples analyzed, ...	7	20	27
Below standard, ...	3	8	11
Above standard, including samples passed,	7	14	21

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
556,	4.47	9.88	14.35	85.65	-
554,	4.16	9.63	13.79	86.21	-
557,	4.25	9.54	13.79	86 21	-
560,	3.75	9.77	13.52	86.48	-
564,	3.51	8.70	12 21	87.79	-
559,	3.09	8.55	11.64	88.36	-
563,	1.62	7.26	8.88	91.12	-

Class B.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
553,	4 43	9.70	14.13	85 87	-
90,	3.97	10.13	14.10	85.90	0.67
550,	3 83	10.22	14.05	85.95	-
88,	4.40	9 64	14 04	85.96	0.65
85,	4.01	9.92	13.93	86 07	0.75
87,	4.55	9.30	13.85	86.15	0 69
91,	3.71	10.12	13 83	86.17	0.70
86,	3.92	9.68	13.60	86.40	0.70
83,	3.56	9 61	13.17	86.83	0 63
81,	3 59	9.48	13 07	86.93	0.71
79,	3 57	9.46	13.03	86.97	0.63
76,	2.37	10.63	13.00	87.00	0.80
562,	3.48	9 50	12 98	87.02	-
89,	3 39	9.53	12.92	87 08	0.73
549,	3.83	9.02	12.85	87 15	-
82,	3 63	9.09	12.72	87 28	0.69
77,	2.85	9.63	12 48	87.52	0.65
78,	3.02	9.19	12.21	87.79	0 64
80,	2.18	9.96	12 14	87.86	0 71
84,	3 40	8.65	12.05	87.95	0.66

Somerville.

	Class A.	Class B.	Total.
Samples received,	31	15	46
Passed on inspection,	7	5	12
Samples analyzed,	24	10	34
Below standard,	23	7	30
Above standard, including samples passed,	8	8	16

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1845, ...	6.06	8.64	14.70	85.30	–
1837, ...	3.47	9.36	12.83	87.17	–
1772, ...	3.30	9.33	12.63	87.37	–
1768, ...	2.81	9.68	12 49	87.51	–
1841, ...	3 21	9.06	12.27	87.73	–
1758, ...	2.49	9.42	11.91	88.09	–
1762, ...	2.61	9.13	11.74	88.26	–
95, ...	2 42	9.20	11.62	88.38	–
96, ...	2.78	8.73	11.51	88.49	–
1851, ...	2.58	8.84	11.42	88.58	0.65
1756, ...	1.60	9.80	11.40	88.60	–
1847, ...	2.77	8 57	11.34	88.66	0.63
504, ...	2.42	8.87	11.29	88.71	–
515, ...	2 42	8.86	11.28	88.72	–
513, ...	2.96	8.17	11.13	88.87	–
1849, ...	2.84	8.12	10 96	89 04	–
1843, ...	2.14	8.81	10.95	89.05	–
94, ...	2 69	7.87	10.56	89.44	–
503, ...	2.80	8.75	10.55	86.45	–
514, ...	2.45	8.10	10.55	89 45	–
98, ...	2.31	8.14	10.45	89.55	–
505, ...	2.26	8.18	10.44	89.56	–
99, ...	1 52	8.32	9.84	90.16	–
97, ...	1.03	8.77	9 80	90.20	–

Class B.

101, ...	3.63	9.95	13.58	86.42	–
507, ...	4.27	9.14	13.41	86.59	–
502, ...	3.61	9.62	13.23	86.77	–
100, ...	3.35	9.55	12.80	87.20	–
508, ...	3.57	8.83	12.40	87 60	–
92, ...	3.42	8.86	12.28	87 72	–
511, ...	3.24	8.89	12.13	87.87	–
1839, ...	3.04	8.51	11.55	88.45	–
102, ...	2.51	8.53	11.04	88.96	–
93, ...	2.64	7.82	10.46	89.54	–

Chelsea.

	Class A.	Class B.	Total.
Samples received,	64	36	100
Passed on inspection,	29	13	42
Samples analyzed,	35	23	58
Below standard,	29	17	46
Above standard, including samples passed,	35	19	54

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
148,	3.46	10.72	14.18	85.82	–
1817,	4.18	9.78	13.96	86.04	–
393,	3.09	10.06	13.15	86.85	–
1829,	3.50	9.60	13.10	86.90	–
357,	4.00	9.04	13.04	86 96	–
710,	3.03	9.99	13.02	86.98	–
351,	2.95	9.74	12.69	87.31	–
356,	2.89	9.67	12.56	87.44	–
361,	2.95	9.52	12.47	87.53	–
362,	2.80	9.56	12.36	87.64	–
397,	2.59	9.48	12.07	87.93	–
360,	3.09	8 96	12.05	87.95	–
390,	2.69	9.17	11.86	88.14	–
147,	2.07	9.77	11 84	88.16	–
382,	1.44	10.33	11.77	88 23	–
1835,	1.94	9.75	11.69	88.31	0 75
489,	2.76	8.88	11.64	88.36	–
396,	2.36	9 27	11.63	83.37	–
154,	1.01	10 37	11.38	88.62	–
348,	2.33	8.92	11.25	88.75	–
358,	1.95	9.26	11.21	88.79	–
715,	2.70	8.47	11.17	88.83	–
354,	2.87	8.19	11.06	88.94	–
349,	2.14	8.86	11.00	89.00	–
714,	1.92	9.05	10.97	89.03	–
355,	1.89	9.04	10.93	89.07	–
395,	1.59	8.92	10 51	89.49	–
713,	1.47	9.03	10.50	89.50	–
151,	1.17	9.24	10.41	89.59	–
387,	0.62	9.55	10.17	89.83	–
359,	0.89	9.20	10.09	89.91	–

Class A — Concluded.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
495, ...	1.84	8.24	10.08	89.92	–
352, ...	1.45	8.54	9.99	90.01	–
496, ...	1.62	8.29	9.91	90.09	–
145, ...	1.47	7.39	8.86	91.14	–

Class B.

230,*	13.71	7.92	21.63*	78.37	–
1825, ...	3.59	10.31	13.90	86.10	–
701, ...	3.31	10.24	13.55	86.45	–
1821, ...	3.10	10.09	13.19	86.81	–
1815, ...	2.94	10.20	13.14	86.86	–
1809, ...	2.98	10.08	13.06	86 94	–
1831, ...	3.49	9.44	12.93	87.07	–
1811, ...	3.08	9.80	12.88	87.12	–
1827, ...	2.67	10.13	12.80	87.20	–
708, ...	3.12	9.52	12.64	87.36	–
709, ...	3.11	9.40	12.51	87.49	–
235, ...	2.04	10.31	12.35	87.65	–
228, ...	2.22	10.09	12.31	87.69	–
226, ...	2.41	9 88	12.29	87.71	–
704, ...	2.73	9.51	12.24	87.76	–
383, ...	2.80	9.21	12.01	87.99	-
486, ...	2.85	9.04	11.89	88.11	–
227, ...	2.64	8.94	11.58	88.42	–
222, ...	1.78	9.71	11.49	88.51	–
229, ...	1.79	9.61	11.40	88 60	–
234, ...	2.48	8.92	11.40	88.60	–
231, ...	2.37	9.00	11 37	88.63	–
1813, ...	1.95	8.85	10.80	89.20	0.73

Salem.

	Class A.	Class B.	Total.
Samples received, ...	15	51	66
Passed on inspection, ...	8	23	31
Samples analyzed, ...	7	28	35
Below standard, ...	6	13	19
Above standard, including samples passed,	9	38	47

* Sold as milk.

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
130, ...	3.74	9.46	13.20	86.80	–
2535, ...	3.47	9.43	12.90	87.10	–
472, ...	2.51	10.27	12.78	87.22	–
462, ...	3.19	9.28	12.47	87.53	–
469, ...	3.58	8.64	12.22	87.78	–
139, ...	2.59	8.54	11.13	88.87	–
2557, ...	1.30	7.12	8.42	91 58	–

Class B.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
2865, ...	4.20	10.43	14.63	85.37	–
621, ...	4.30	10.32	14.62	85.38	–
618, ...	4.71	9.83	14.54	85.46	–
627, ...	3.99	10.50	14.49	85.51	–
620, ...	4.58	9.82	14 40	85.60	–
619, ...	4.48	9.87	14.35	85.65	–
629, ...	4.69	9.57	14.26	85.74	–
2863, ...	4.06	10.16	14.22	85.78	–
2855, ...	4.57	9.43	14.00	86.00	–
459, ...	3.48	10.27	13.75	86.25	–
628, ...	3.31	10.19	13.50	86.50	–
625, ...	3.93	9.53	13.46	86.54	–
2867, ...	3.28	10.15	13.43	86.57	–
2849, ...	3.33	9.81	13.14	86.86	–
2553, ...	3.53	9.54	13.07	86.93	–
622, ...	4.12	8.74	12.86	87.14	–
631, ...	3.07	9.62	12.69	87.31	–
463, ...	3.36	9.32	12.68	87.32	–
630, ...	3.25	9.33	12.58	87.42	–
2531, ...	3.01	9.55	12.56	87.44	–
2847, ...	2.83	9.73	12.56	87.44	–
623, ...	2.50	10.02	12.52	87.48	–
624, ...	3.81	8.66	12.47	87.53	–
2851, ...	3.23	8.85	12.08	87.92	–
468, ...	2.94	8.88	11.82	88.18	–
2545, ...	3.12	8.17	11.29	88.71	–
2539, ...	1.01	10.04	11.05	88.95	–
138, ...	1.83	7.69	9.52	90.48	–

Gloucester.

	Class A.	Class B.	Total.
Samples received,	7	23	30
Passed on inspection,	2	12	14
Samples analyzed,	5	11	16
Below standard,	3	7	10
Above standard, including samples passed,	4	16	20

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
2361,	4.09	9.56	13.65	86.35	–
2363,	2.67	10.66	13.33	86.67	–
2351,	2.91	9.49	12.40	87.60	–
2371,	2.20	9.74	11.94	88.06	–
2365,	3.88	7.81	11.69	88.31	–

Class B.

2353,	4.05	10.15	14.20	85.80	–
2349,	3.84	10.25	14.09	85.91	–
2345,	3.32	9.92	13.24	86.76	–
2359,	3.30	9.81	13.11	86.89	–
2343,	2.87	10.10	12.97	87.03	–
2341,	2.38	9.24	11.62	88.38	–
196,	2.08	9.30	11.38	88.62	–
188,	2.93	8.05	10.98	89.02	–
187,	2.40	8.51	10.91	89.09	–
195,	2.66	7.60	10.26	89.74	–
189,	2.24	7.55	9.79	90.21	–

Newburyport.

	Class A.	Class B.	Total.
Samples received,	15	39	54
Passed on inspection,	1	17	18
Samples analyzed,	14	22	36
Below standard,	3	7	10
Above standard, including samples passed,	12	32	44

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
2414,*	12.14	9.47	21.61*	78.39	–
2420, ...	5.67	10.30	15 97	84.03	–
1864, ...	6.28	9.63	15.91	84.09	–
2416, ...	5.57	9.86	15.43	84.57	–
1870, ...	4.33	9.61	13.94	86.06	–
1856, ...	2.61	11.18	13.79	86 21	–
1880, ...	3.82	9.75	13.57	86.43	–
1868, ...	3.26	9.97	13.23	86.77	–
1862, ...	3.04	10.10	13.14	86 86	–
1872, ...	3 10	9.96	13.06	86.94	–
1858, ...	3.55	9.47	13.02	86.98	–
1876, ...	2.82	10.09	12.91	87.09	–
1866, ...	2 94	9.60	12.54	87.46	–
1874, ...	2 75	9.23	11.98	88.02	–

Class B.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
2418,*	16.61	9.45	26.06*	73.94	–
2424, ...	4.46	10.92	15.38	84.62	–
2422, ...	4 93	9.77	14.70	85.30	–
575, ...	3.82	10.66	14.48	85.52	–
2412, ...	4.23	9.52	13.75	86.25	–
2426, ...	4.59	9.07	13.66	86.34	–
2428, ...	3.15	10.46	13.61	86 39	–
2410, ...	3.37	10.17	13.54	86.46	–
579, ...	3 21	10.16	13.37	86.63	–
1860, ...	3.72	9.62	13.34	86.66	–
571, ...	3.47	9.79	13 26	86.74	–
567, ...	3.40	9.80	13.20	86.80	–
570, ...	3.47	9.68	13.15	86.85	–
568, ...	3.24	9.89	13.13	86.87	–
569, ...	3.38	9.70	13.08	86.92	–
2430, ...	2.70	10.20	12 90	87.10	–
573, ...	2.72	10.02	12.74	87.26	–
566, ...	3.07	9.58	12.65	87.35	–
164, ...	2.35	10 19	12.54	87.46	–
565, ...	2.77	9.33	12.10	87.90	–
169, ...	2.63	9.29	11.92	88.08	–
167, ...	2.30	9 37	11.67	88.33	–

* Sold as milk.

Brockton.

	Class A.	Class B.	Total.
Samples received,	10	27	37
Passed on inspection,	–	11	11
Samples analyzed,	10	16	26
Below standard,	5	7	12
Above standard, including samples passed,	5	20	25

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1531,	3.59	10.53	14.12	85.88	–
1346,	4.11	9.75	13.86	86.14	0.70
1335,	4.96	8.77	13.73	86.27	0.62
1342,	3.62	10.06	13.68	86.32	0 65
1345,	3.95	9.58	13.53	86.47	0 63
1344,	2.61	9.81	12 42	87.58	0 66
1333,	2.20	8.54	10.74	89.26	0.64
1347,	2.71	7.65	10.36	89.64	0.44
1334,	2.86	7.40	10.26	89.74	0 40
1530,	1.94	7.59	9.53	90.47	0.45

Class B.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1337,	4.29	9.69	13 98	86.02	0.62
1339,	3.94	9.77	13.71	86.29	0 65
1526,	2.79	10.87	13.66	86.34	–
1338,	3.78	9.77	13.55	86.45	0.65
1095,	3.80	9.60	13.40	86.60	–
1534,	3.17	10.10	13.27	86 73	–
1096,	3.86	9 35	13.21	86.79	–
1341,	3.41	9.79	13.20	86.80	0.62
1348,	3.08	9.96	13.04	86.96	0.58
1340,	3.51	9.21	12.72	87.28	0.63
1102,	2.92	9.66	12.58	87.42	–
1336,	3.40	8.79	12.19	87.81	0.56
1099,	3.01	8.89	11.90	88.10	–
1343,	2.34	8.48	10.82	89.18	0.54
1094,	2.59	8.10	10.69	89.31	–
1093,	1.60	8.48	10.08	89.92	–

Taunton.

	Classes A and B.
Samples received,	20
Passed on inspection,	13
Samples analyzed,	7
Below standard,	4
Above standard, including samples passed,	16

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1362,	5.63	9.81	15.44	84.56	-
1360,	3.12	10.16	13.28	86.72	0.68
1361,	3.92	9.35	13.27	86 73	-
1364,	2 98	9.31	12.29	87.71	-
1359,	2 51	9.69	12.20	87.80	0.68
1060,	2.61	8.66	11.27	88 73	-
1363,	0.81	9.51	10.32	89 68	-

New Bedford.

	Classes A and B.
Samples received,	32
Passed on inspection,	22
Samples analyzed,	10
Below standard,	9
Above standard, including samples passed,	23

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1075,	2.41	11.29	13.70	86.30	0.74
1201,	2.75	10.22	12 97	87.03	-
1083,	2.79	9.61	12.40	87.60	-
1196,	2 20	9.98	12.18	87.82	-
1195,	2.37	9.76	12.13	87.87	-
1070,	3.31	8.70	12.01	87.99	-
1202,	2.62	9.25	11.87	88.13	-
1194,	2.42	9.23	11.65	88.35	-
1071,	2.55	9.02	11.57	88.43	-
1082,	2.52	8.22	10.74	89.26	-

Provincetown.

	Classes A and B.
Samples received,	10
Samples analyzed,	10
Below standard,	5
Above standard,	5

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1325, ...	5.18	10.12	15.30	84.70	0.65
1330, ...	4.68	10.14	14.82	85.18	0.62
1329, ...	4 65	9.62	14.27	85.73	0.60
1331, ...	4.12	9.75	13.87	86.13	0.66
1328, ...	4.03	9.31	13.34	86.66	0.58
1327, ...	3.18	9.78	12.96	87.04	0.63
1332, ...	2.84	9.38	12.22	87.78	0.61
1323, ...	2.46	9.03	11.49	88.51	0.60
1324, ...	2 89	8.54	11.43	88.57	0.59
1326, ...	2.59	7.08	9.67	90.33	0.43

Waltham.

	Class A.	Class B.	Total.
Samples received, ...	7	10	17
Passed on inspection, ...	3	2	5
Samples analyzed, ...	4	8	12
Below standard, ...	4	7	11
Above standard, including samples passed,	3	3	6

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1375, ...	2.11	9.20	11.31	88.69	-
1376, ...	1.48	9.61	11.09	88.91	-
1374, ...	1.26	9.64	10.90	89.10	-
1379, ...	1.95	8.19	10.14	89.86	-

Class B.

1509, ...	3.71	9.88	13.59	86.41	-
1369, ...	3.23	9.29	12.52	87.48	-
1370, ...	2.71	9.71	12.42	87.58	-
1511, ...	3.37	9 05	12.42	87.58	-
1372, ...	2.54	9.44	11.98	88.02	-
1506, ...	3.04	8.47	11.51	88.49	-
1377, ...	2.62	8.76	11.38	88 62	-
1371, ...	2.48	8.83	11.31	88.69	-

WOBURN.

	Classes A and B.
Samples received, ...	29
Passed on inspection, ...	12
Samples analyzed, ...	17
Below standard, ...	10
Above standard, including samples passed, . . .	19

INSPECTOR'S NUMBER.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
425,*	12.87	9.02	21.89*	78.11	0.62
2454, ...	3 87	10.03	13.90	86.10	–
2452, ...	3.71	10.10	13.81	86.19	–
2456, ...	4.09	9.50	13.59	86.41	–
513, ...	4.47	8.82	13.29	86.71	–
431, ...	3.26	10.10	13.26	86.74	0.63
652, ...	3.77	9.48	13.25	86.75	–
432, ...	2.89	9.79	12.68	87.32	0.69
646, ...	3.03	9.62	12.65	87.35	–
2464, ...	3.75	8.85	12.60	87.40	–
2466, ...	3.16	9.38	12.54	87.46	–
2460, ...	3.59	8.63	12.22	87 78	–
429, ...	3 39	8.60	11.99	88 01	0.57
428, ...	2.94	8.70	11.64	88.36	0.60
2458, ...	1.49	9 03	10.52	89 48	–
2462, ...	2.52	7.80	10.32	89.68	–
424, ...	2.35	7.49	9.84	90.16	0.48

FITCHBURG.

	Classes A and B.
Samples received, ...	16
Passed on inspection, ...	11
Samples analyzed, ...	5
Below standard, ...	4
Above standard, including samples passed, . . .	12

INSPECTOR'S NUMBER.	Fat.	Solids. not Fat.	Total Solids.	Water.	Ash.
1281, ...	3.03	9.18	13.21	86.79	–
1271, ...	3 49	9.49	12.98	87.02	–
1270, ...	3.39	8.91	12.30	87.70	–
1272, ...	2.56	9.60	12.16	87.84	–
1275, ...	0.42	9.29	9.71	90.29	–

* Sold as milk.

Malden.

	Class A.	Class B.	Total.
Samples received,	12	27	39
Passed on inspection,	1	15	16
Samples analyzed,	11	12	23
Below standard,	9	11	20
Above standard, including samples passed,	3	16	19

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
2005,	3.48	11.18	14.66	85.34	-
1904,	3.92	9.98	13.90	86.10	-
1997,	2.75	9.81	12.56	87.44	-
1900,	2.65	9.72	12.37	87.63	-
1991,	2.55	9.81	12.36	87.64	-
2001,	3.15	8.96	12.11	87.89	-
1995,	3.01	8.85	11.86	88.14	-
1896,	2.69	8.99	11.68	88.32	-
2009,	1.85	9.29	11.14	88.86	-
1894,	1.20	9.25	10.45	89.55	-
1892,	2.43	7.69	10.12	89.88	-

Class B.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
2007,	3.42	9.77	13.19	86.81	
1985,	3.12	9.84	12.96	87.04	-
1989,	3.10	9.78	12.88	87.12	-
640,	3.62	9.18	12.80	87.20	
1884,	3.54	9.23	12.77	87.23	-
641,	3.22	9.25	12.47	87.53	-
1999,	2.81	9.60	12.41	87.59	-
1987,	2.84	9.51	12.35	87.65	-
1882,	3.20	8.98	12.18	87.82	-
637,	3.04	9.05	12.09	87.91	-
638,	2.97	9.09	12.06	87.94	-
635,	2.92	8.88	11.80	88.20	-

Clinton.

	Class B.
Samples received,	25
Passed on inspection,	9
Samples analyzed,	16
Below standard,	8
Above standard, including samples passed, and one sample of skimmed milk of good quality,	17

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
2432, ...	3.79	10.08	13.87	86.13	-
2436, ...	3.36	10.19	13.55	86.45	-
2440, ...	3.32	10.18	13.50	86.50	-
1388, ...	3.58	9.90	13.48	86.52	-
2444, ...	3.74	9.58	13.32	86 68	-
1386, ...	3.29	10.02	13.31	86.69	-
2438, ...	3.76	9.49	13.25	86.75	-
1392, ...	3.30	9.65	12.95	87.05	-
2442, ...	3.62	9.25	12.87	87.13	-
2446, ...	-	-	12.69	87.31	-
2450, ...	3.79	8.81	12.60	87.40	-
1380, ...	2.79	9.77	12.56	87.44	-
2448, ...	3.15	9.40	12.55	87.45	-
1385, ...	2.89	9.65	12.54	87.46	-
2434, ...	1.62	10.09	11.71	88.29	-
1390,*	0.43	10.76	11.19	88.81	-

Hyde Park.

	Class A.	Class B.	Total.
Samples received, ...	15	16	31
Passed on inspection, ...	1	2	3
Samples analyzed, ...	14	14	28
Below standard, ...	10	6	16
Above standard, including samples passed,	5	10	15

Class A.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1431, ...	3.86	10.68	14.54	85.46	-
1210, ...	3.96	10.27	14.23	85.77	-
1427, ...	3.92	10.23	14 15	85.85	-
1432, ...	3.64	10.03	13.67	86.33	-
1166, ...	4.22	8.60	12.82	87.18	-
1215, ...	3.00	9.44	12.44	87.56	-
1216, ...	2.83	9.48	12.31	87.69	-
1428, ...	3.00	9.25	12.25	87 75	-
1212, ...	2.97	9 23	12.20	87.80	-
1165, ...	3.61	8.23	11.84	88.16	-

* Sold as "skimmed milk."

Class A — Concluded.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1211,	2.85	8.92	11.77	88.23	0.63
1168,	2.74	8.78	11 52	88.48	-
1433,	1.70	9.31	11.01	88.99	-
1167,	2.00	8.77	10.77	89 23	-

Class B.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1429,	5.39	10.40	15.79	84.21	-
1214,	5.56	9.53	15,09	84.91	0.67
1425,	4.35	9.69	14.04	85.96	-
1424,	3.49	10.30	13.79	86.21	-
1430,	4.39	9.24	13 63	86.37	-
1423,	3.64	9 84	13 48	86.52	-
1217,	3.83	9 63	13 46	86.54	-
1209,	3 29	9.86	13.15	86.85	-
1426,	3 98	8.87	12.85	87.15	-
1213,	2.92	9.88	12.80	87 20	-
1162,	1.97	9 24	11.21	88.79	-
1160,	2.82	8.32	11.14	88.86	-
1161,	2.27	7.98	10.25	89.75	-
1159,	1 41	8.47	9 88	90.12	-

Newton.

	Classes A and B.
Samples received,	15
Passed on inspection,	7
Samples analyzed,	8
Below standard,	7
Above standard, including samples passed,	8

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1003,	9.21	9 34	18.55	81 45	-
1018,	2.69	9.85	12.54	87.46	-
1026,	2 59	9.90	12 49	87.51	-
1017,	2 46	9.99	12.45	87 55	-
1022,	2.81	9.02	11.83	88.17	-
1027,	1.73	9.94	11.67	88.33	-
1021,	3 52	8.06	11.58	88.42	-
1025,	1.26	9.96	11.22	88.78	-

Quincy.

	Classes A and B.
Samples received, ...	7
Samples analyzed, ...	7
Below standard, ...	7

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1028, ...	2.70	10.27	12.97	87.03	–
1030, ...	2.58	10.32	12.90	87.10	–
1031, ...	3.16	9.70	12.86	87.14	–
1034, ...	2.90	9.89	12.79	87.21	–
1033, ...	3.44	9.30	12 74	87.26	–
1029, ...	3.21	8.87	12.08	87.92	–
1032, ...	2.15	7.93	10.08	89 92	–

Brookline.

	Classes A and B.
Samples received, ...	17
Passed on inspection, ...	9
Samples analyzed, ...	8
Below standard, ...	6
Above standard, including samples passed, . . .	11

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
	4 80	9.77	14.57	85.43	–
	3.84	9.96	13.80	86.20	–
	3.44	8.76	12.20	87.80	–
1115, ...	2.17	9.92	12.09	87.91	–
1124, ...	2.54	9.31	11.85	88.15	–
	3.34	8.36	11.70	88.30	–
1123, ...	2.71	8.77	11 48	88.52	–
	2.11	9.22	11.33	88.67	0.60

Other Towns.

Attleborough.	Marlborough.	Wakefield.
North Attleborough.	Milford.	Watertown.
Dedham	Plymouth.	Weymouth.

	Classes A and B.
Samples received,	86
Passed on inspection,	41
Samples analyzed,	45
Below standard,	24
Above standard, including samples passed, and 3 skimmed milks of good quality,	62

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1038,	6.22	10.43	16.65	83.35	-
1112,	6.09	8.94	15.03	84.97	-
1306,	4.90	9.76	14.66	85.34	0.64
-	4.71	9.63	14.34	85.66	-
1737,	3.84	10.10	13.94	86.06	-
1030,	3.58	10.34	13 92	86.08	-
-	4.29	9.58	13.87	86.13	-
1170,	3.59	10.06	13.65	86.35	-
1417,	3 28	10.33	13.61	86.39	-
1035,	3.14	10.41	13.55	86.45	-
1551,	3.47	10.07	13.54	86.46	-
1037,	3.79	9.47	13.26	86.74	-
1415,	3.40	9.86	13.26	86.74	-
1175,	2.90	10.33	13.23	86.77	-
1309,	3.66	9.56	13.22	86.78	0 70
1366,	3.38	9.82	13.20	86 80	-
1108,	2.62	10.49	13.11	86.89	-
1172,	2.91	10.13	13.04	86.96	-
1741,	3.43	9.47	12.90	87.10	-
1739,	3.23	9.56	12.79	87.21	-
1735,	3.32	9.46	12.78	87.22	-
1365,	3.45	9.31	12.76	87.24	-
1419,	3.06	9.65	12.71	87.29	-
1313,	3.31	9.25	12.56	87.44	0.72
1421,	3.78	8.62	12 40	87.60	-
1413,	3.43	8.86	12.29	87.71	-
1171,	3.01	9.25	12.26	87.74	-

Other Towns — Concluded.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
1733, ...	3.05	9.12	12.17	87.83	–
1303, ...	3.35	8.79	12.14	87.86	0.64
1111, ...	2.87	9.22	12 09	87.91	–
1109, ...	2.45	9.63	12.08	87.92	–
1367, ...	3.10	8.98	12.08	87.92	–
1731, ...	3.20	8.82	12.02	87.98	–
1105, ...	2.75	9.18	11.93	88.07	–
1086, ...	2.88	9.01	11.89	88.11	–
1368, ...	1.59	10.03	11.62	88.38	–
513, ...	1.86	9.50	11.36	88.64	–
1173, ...	2.65	8.48	11.13	88.87	–
1092, ...	2.63	8.27	10.90	89.10	–
1114, ...	1.80	8.99	10.79	89.21	–
–	1.90	8.68	10 58	89.42	–
–	3.12	7.02	10.14	89.86	–
1549,*	0.14	10.14*	10.28	89.72	–
1553,*	–	10.13*	10.13	89.87	–
1552,*	–	10.06*	10.06	89.94	–

* Sold as skimmed milk.

Class C.

Samples obtained from Producers.

The samples which were obtained directly from the producers are not to be taken as in any way an indication of the quality of the general supply, coming as they did from farmers who were suspected by contractors and others of watering or otherwise tampering with their milk. All of the samples of this class were taken from cans which were ready for shipment to the contractors in Boston and elsewhere.

Samples received,	136
Passed on inspection,	40
Samples analyzed,	96
Below standard,	71
Above standard, including samples passed,	65

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.	
1127,	0.90	5.40	6.30	93.70	0.33	
1128,	1.57	5.98	7.55	92.45	0.33	
1129,	1.20	5 42	6.62	93.38	0 34	*
1130,	2.32	5.98	8.30	91.70	0.32	
1131,	1.57	5.88	7.45	92 55	0.35	
1132,	1.61	5.64	7.25	92.75	0.34	
1333,	–	–	13.72	86.28	–	
1334,	–	–	12.93	87.07	–	
1135,	1.67	9.92	11.59	88.41	0.54	
1136,	2.95	8.30	11.25	88.75	0.53	*
1137,	2.94	8.45	11.39	88.61	0.50	
1139,	2.08	5.55	7.63	92.37	0.28	
1140,	1.43	6.82	8.25	91.75	0.42	*
1141,	2.28	7.90	10.18	89.82	0.40	
1218,	2.27	7.78	10.05	89.95	0.55	
1219,	2.65	7.66	10.31	89.69	0.53	*
1220,	2 56	8.22	10.78	89.22	0.63	
1228,	3.69	10.63	14.32	85.68	–	
1229,	3.35	10.13	13.48	86.52	–	
1230,	3 12	9.65	12.77	87.23	–	
1461,	2.29	5.67	7.96	92.04	0.37	
1462,	2.30	5.77	8.07	91.93	0.38	*
1463,	2.57	5.94	8.51	91.49	0.37	
1464,	2.23	5.16	7.39	92.61	0.31	

* From one dairy.

Class C — Continued.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.	
1465,	3.24	7.94	11.18	88 82	0.50	
1466,	2.79	8 27	11.06	88 94	0.54	
1468,	3.29	8.39	11.68	88.32	0.54	
1645,	3.05	9.74	12.79	87.21	–	
1647,	3.36	10.26	13.62	86.38	–	
1655,	2.84	9.56	12.40	87.60	–	
1657,	2.51	9.38	11.89	88.11	–	
1661,	2.95	9.52	12.47	87.53	–	
1665,	3.42	10.01	13.43	86.57	–	
1667,	3.01	9.18	12.19	87.81	–	
1913,	3.32	8.91	12.23	87.77	0.54	
1915,	2.68	8.81	11.49	88.51	0.52	
1917,	4.37	8.36	12.73	87.27	0.53	*
1919,	2.05	8.89	10.94	89.06	0.55	
1921,	2.47	8.62	11.09	88.91	0.55	
1923,	2 76	8.85	11.61	88.39	0.52	
1925,	4.83	10.26	15.09	84.91	0.70	
1927,	5.07	10.05	15.12	84.88	0.64	
2203,	3.16	8.99	12.15	87.85	0.59	
2205,	2.57	8.77	11.34	88.66	0.52	
2207,	2.93	9.28	12.21	87.79	0.63	
2209,	2.87	9.02	11.89	88.11	0 54	
2211,	2.86	9.07	11.93	88.07	0.60	*
2213,	2.77	8.46	11.23	88.77	0.57	
2215,	2.88	9.22	12.10	87.90	0.59	
2217,	2.61	9.05	11.66	88.34	0.58	
2787,	2.45	7.75	10.20	89.80	–	
2801,	3.08	8.41	11.49	88.51	–	
2809,	2.11	8.51	10.62	89.38	–	*
2815,	2.69	9.42	12.11	87.89	–	
2567,	3.85	9.41	13.26	86.74	–	
2569,	3.86	9.43	13.29	86.71	–	
2571,	3.85	9.32	13.17	86.83	–	*
2573,	4.07	8.80	12.87	87.13	–	
2575,	3.14	9.49	12.63	87.37	–	
2577,	3.67	9.49	13.16	86.84	–	
103,	3.05	10.12	13.17	86.83	–	*
104,	4.18	10.14	14.32	85.68	–	

* From one dairy.

Class C — Concluded.

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.	
105, ...	2.12	9 38	11.50	88.50	–	*
106, ...	2.95	9.61	12.56	87.44	–	*
107, ...	4.22	9.63	13.85	86.15	–	*
108, ...	4.03	9.52	13.55	86.45	–	*
109, ...	4.54	9.65	14.19	85.81	–	*
110, ...	2.06	10.43	12.49	87.51	–	*
111, ...	2 87	9.19	12 06	87.94	–	*
112, ...	2.93	9.26	12.19	87.81	–	*
113, ...	2.26	9.15	11.41	88.59	–	*
114, ...	3.63	10 14	13.77	86.23	–	*
398, ...	3.51	9.76	13.27	86.73	0 59	*
399, ...	3.55	9.82	13.37	86 63	0 61	*
400, ...	2.53	9.59	12.12	87.88	0.58	*
401, ...	3.74	10 10	13.84	86.16	0.60	*
402, ...	2.95	9.58	12.53	87.47	0.60	*
403, ...	3.37	9.54	12.91	87.09	0.63	*
404, ...	2.83	9.78	12.61	87.39	0.61	
405, ...	3.11	10.20	13.31	86.69	0.67	
695, ...	2.88	9.48	12 36	87.64	–	
698, ...	2.95	9.42	12.37	87.63	–	
699, ...	2 82	11.10	13.92	86.08	–	
684, ...	3.94	8.88	12.82	87.18	–	*
685, ...	3.05	8.71	11.76	88.24	–	*
686, ...	3.76	8.55	12.31	87.69	–	*
687, ...	3 43	9.07	12.50	87.50	–	*
688, ...	3.61	8.44	12.05	87.95	–	*
689, ...	2.95	9.29	12.24	87.76	–	
691, ...	2.98	7.64	10.62	89.38	0.50	
653, ...	3.48	8.65	12.13	87.87	–	
657, ...	3.37	8.50	11.87	88.13	0.50	
658, ...	3.23	9.00	12.23	87.77	–	
659, ...	3.55	9.93	13.48	86.52	–	*
660, ...	4.28	10.29	14.57	85.43	–	*
665, ...	3.19	9.88	13.07	86.93	–	

* From one dairy.

Class D.

This class comprises all samples of unknown source, most of which were brought in or sent in by private individuals.

Samples received,	30
Samples analyzed,	30
Below standard,	23
Above standard,	7

Inspector's Number.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
	5.65	10.18	15.83	84.17	–
	4.99	9.72	14.71	85.29	0.68
	4.33	10.11	14.44	85.56	0.45
	3.87	10.19	14.06	85.94	–
	3.73	10.05	13.78	86.22	–
	3.09	10.37	13.46	86.54	–
	3.35	9.74	13.09	86.91	–
	3.37	9.50	12.87	87.13	–
	3.15	9.70	12.85	87.15	–
	3.21	9.50	12.71	87.29	–
	3.77	8.85	12.62	87.38	–
	2.68	9.84	12.52	87.48	–
	3.10	9.32	12.42	87.58	–
	3.45	8.96	12.41	87.59	–
	3.05	9.36	12.41	87.59	–
	3.89	8.40	12.29	87.71	–
	1.96	10.20	12.16	87.84	–
	3.20	8.93	12.13	87.87	0.54
	2.68	9.35	12.03	87.97	–
	2.60	9.37	11.97	88.03	–
	2.50	9.46	11.96	88.04	–
	3.24	8.72	11.96	88.04	–
	2.87	8.79	11.66	88.34	0.50
	2.88	8.74	11.62	88.38	–
	2.06	9.42	11.48	88.52	–
	3.13	7.97	11.10	88.90	0.54
	3.05	7.97	11.02	88.98	–
	2.83	7.97	10.80	89.20	–
	2.90	7.75	10.65	89.35	–
	2.41	7.81	10.22	89.78	–

Class E.

The samples of this class were milked in the presence of the inspectors or other authorized agents. Each sample represents an entire milking of one or more cows. The average of total solids given below is calculated for 185 cows represented by 98 samples.

Where Obtained.	Age of Cow.	Time since Calving.	Breed.	Character of Feed.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
Danvers Lunatic Hospital,	–	–	–	– – –	3.20	9.81	13.01	86.99	–
" " "	–	–	–	– – –	4.95	9.41	14.36	85 64	–
" " "	–	–	–	– – –	5.90	9.06	14.96	85.04	–
Medford,	–	8 months.	–	Brewers' grains,	3.84	9.57	13.41	86.59	0.68
"	–	3 weeks.	–	" "	3.27	9.15	12.42	87.58	0.75
"	–	21 months.	–	" "	3.35	10.03	13.38	86.62	0.76
State Almshouse, Tewksbury,	5 years.	5 months.	Holstein.	Hay, shorts and cotton meal,	3.56	9.10	12.66	87.34	0.71
" " "	5 years.	6 weeks.	"	" " "	3.39	8.05	11.44	88.56	0.74
" " "	5 years.	3½ months.	"	Ensilage, shorts and cotton meal,	4.07	9.01	13 08	86.92	0.72
" " "	8 years.	4 months.	Durham.	" " "	3.71	8.17	11.88	88.12	0.68
" " "	7 years.	3 months.	"	" " "	4.16	8.66	12.82	87.18	0.66
" " "	5 years.	5 months.	Holstein.	Hay, shorts and cotton meal,	3.68	9.26	12.94	87.06	0.71
" " "	5 years.	6 weeks.	" *	" " "	3.61	8.80	12.41	87.59	0.64
" " "	5 years.	3½ months.	"	Ensilage, shorts and cotton meal,	4.56	9.09	13.65	86.35	0.73
" " "	8 years.	4 months.	Durham.	" " "	3 36	8.72	12.08	87.92	0.68

* Spayed 4 weeks before.

Where Obtained.	Age of Cow.	Time since Calving.	Breed.	Character of Feed.	Fat.	Solids, not Fat.	Total Solids	Water.	Ash.
State Almshouse, Tewksbury, . .	7 years.	3 months.	Durham.	Ensilage, shorts and cotton meal, . .	4.92	8.44	13.36	86.64	0.76
" " " . .	–	–	(5 cows)	mixed milk, ...	4.02	9.16	13.18	86.82	0.66
" " " . .	–	–	"	"	3.57	9.19	12.76	87.24	0.71
" " " . .	–	–	"	"	3.56	8 54	12.10	87.90	0.68
" " " . .	5 years.	12 weeks.	Holstein.	Ensilage and hay, ...	2 93	8.74	11.67	88.33	0.69
" " " . .	5 years.	17 weeks.	"	" "	4.36	8.02	12.38	87.62	0.69
" " " . .	9 years.	6 weeks.	Native.	" "	4.37	8.53	12.90	87.10	0.69
" " " . .	7 years.	15 weeks.	Holstein.	" "	3.55	8.93	12.48	87.52	0.64
" " " . .	7 years.	18 weeks.	Durham.	" "	3.36	8.74	12.10	87.90	0.69
Lawrence (private farm), . . .	Each sample from five cows.		Native.	Hay, meal brewers' grains, ...	2.76	9.59	12.35	87.65	0.66
" " " . . .			"	" " "	2.33	10.22	12 55	87.45	0.65
" " " . . .			"	" " "	2.74	10.04	12.78	87.22	0.69
Andover (private farm), . . .	Each sample from six cows.		"	Meal, hay, shorts, grass, ...	2.32	9.92	12.24	87.76	0.65
" " " . . .			"	" " "	2.61	9.39	12.00	88.00	0.61
" " " . . .			"	" " "	2.95	9.97	12.92	87.08	0.71
" " " . . .			"	" " "	2.60	9.95	12.55	87.45	0.65
Lowell (private farm), . . .	5 years.	–	Durham.	Each cow fed as follows: 1 qt. rye meal, 2 qts. cotton-seed meal, 3 qts. shorts, and cabbage leaves.	2.60	9.40	12.00	88.00	0.69
" " " . . .	5 years.	–	"	" " " "	3.29	9.27	12.56	87.44	0 66
" " " . . .	8 years.	–	"	" " " "	2.80	8.45	11.25	88.75	0.51
" " " . . .	7 years.	–	"	" " " "	5.00	9.21	14.21	85.79	0.59

" " " . . .	8 years.	–	"	" " " "	2.69	8.99	11.68	88.32	0.62
" " " . . .	5 years.	–	"	" " " "	2.64	9.57	12.21	87.79	0.68
" " " . . .	6 years.	–	"	" " " "	3.01	9.45	12.46	87.54	0.61
" " " . . .	–	–	"	" " " "	3.06	9.26	12.32	87.68	0.59
" " " . . .	7 years.	–	Native.	" " " "	4.10	9.60	13.70	86.30	0.62
" " " . . .	9 years.	–	"	" " " "	3.24	9.09	12.33	87.67	0.60
" " " . . .	7 years.	–	"	" " " "	2.73	11.04	13.77	86.23	0.70
" " " . . .	5 years.	–	"	" " " "	3.76	9.69	13.45	86.55	0.69
" " " . . .	7 years.	–	"	" " " "	3.90	10.04	13.94	86.06	0.66
" " " . . .	7 years.	–	"	" " " "	4.64	9.25	13.89	86.11	0.68
" " " . . .	–	–	"	" " " "	3.58	9.40	12.98	87.02	0.60
Danvers Lunatic Hospital, . . .	7 years.	–	–	Each cow received 2 qts. corn meal, 4 qts. shorts, 2 qts cotton-seed meal, about a bushel of ensilage, and good English hay.	5.53	9.16	14.69	85.31	0.63
" " " . . .	19 months.	5 weeks.	–	" " " "	2.91	9.07	11.98	88.02	0.68
" " " . . .	6 years.	–	–	" " " "	3.35	9.51	12.86	87.14	0.66
" " " . . .	6 years.	–	–	" " " "	5.22	9.02	14.24	85.76	0.74
" " " . . .	4 years.	–	–	" " " "	4.49	10.03	14.52	85.48	0.72
" " " . . .	3 years.	–	–	" " " "	4.67	10.04	14.71	85.29	0.69
" " " . . .	4 years.	–	–	" " " "	4.32	10.18	14.50	85.50	0.67
" " " . . .	9 years.	–	–	" " " "	4.19	9.05	13.24	86.76	0.66
" " " . . .	10 years.	–	–	" " " "	4.09	10.01	14.10	85.90	0.76
" " " . . .	10 years.	–	–	" " " "	3.63	9.21	12.84	87.16	0.63
" " " . . .	5 years.	–	–	" " " "	3.03	9.24	12.27	87.73	0.66

Where Obtained.	Age of Cow.	Time since Calving.	Breed.	Character of Feed.	Fat.	Solids, not Fat.	Total Solids.	Water.	Ash.
Danvers Lunatic Hospital,	5 years.	-	-	Each cow received 2 qts. corn meal, 4 qts. shorts, 2 qts. cotton-seed meal, about a bushel of ensilage and good English hay.	6.06	8.57	14.63	85.37	0 54
" " "	6 years.	-	Jersey.	" " " "	5.24	9.90	15.14	84.86	0.75
" " "	12 years.	-	-	" " " "	4 25	10.20	14.45	85.55	0.67
" " "	5 years.	-	-	" " " "	4.64	10.62	15.26	84.74	0.78
" " "	-	(15 cows) mixed milk.		" " " "	4.37	9.37	13.74	86.26	0.65
Taunton Lunatic Hospital,	-	3¼ weeks.	Jersey.	Cut hay, corn meal and shorts,	2.05	10.43	12.48	87.52	0.72
" " "	-	19 months.	Dutch.	" " "	4.77	10.58	15.35	84.65	0.73
" " "	-	3 months.	Ayrshire.	" " "	3.01	8.84	11.85	88.15	0.65
" " "	-	6 months.	Native.	" " "	3.08	8.98	12.06	87.94	0.65
" " "	-	1 month.	Devon.	" " "	3.66	10.69	14.35	85.65	0.70
" " "	-	-	Native.	" " "	3.81	9 96	13.77	86 23	0.71
" " "	-	2 months.	Durham.	" " "	4.39	11.28	15.67	84 33	0.77
" " "	-	6 months.	Jersey.	" " "	1.24	9.80	11.04	88.96	0.79
" " "	-	Mixed	milk from	11 cows,	2.76	9.80	12.56	87.44	0.75
" " "	-	"	"	4 cows,	2.88	10.22	13.10	86.90	0.65
Worcester Lunatic Asylum,	7 years.	6 months.	Mixed.	Shorts and hay,	4.67	10.13	14.80	85.20	0.74
" " "	9 years.	4 months.	Durham.	" "	2.80	9.04	11.84	88.16	0.70
" " "	5 years.	6 months.	Dutch.	" "	4.67	10.25	14.92	85.08	0.75
" " "	7 years.	12 months.	Dutch.	" "	3.90	8.40	12.30	87 70	0 68
" " "	6 years.	5 months.	Mixed.	" "	3.65	9.23	12.88	87.12	0.69

" " " . .	8 years.	6 months.	Durham.	" "	3.67	9 92	13.59	86 41	0.70
" " " . .	6 years.	7 months.	Devon.	" "	4.17	10.94	15.11	84.89	0.75
" " " . .	9 years.	6 months.	Durham.	" "	2.88	9.69	12.57	87.43	0.69
" " " . .	6 years.	4 months.	Mixed.	" "	3.45	9.24	12.69	87.31	0.67
" " " . .	8 years.	5 months.	Ayrshire.	" "	3.02	9.50	12.52	87.48	0.61
" " " . .	7 years.	6 months.	Durham.	" "	2 76	9.56	12.32	87.68	0.63
" " " . .	9 years.	3 months.	Durham.	" "	4.02	9.37	13.39	86 61	0.74
" " " . .	8 years.	6 months.	Durham.	" "	3.11	9.16	12.27	87.73	0.71
" " " . .	7 years.	4 months.	Mixed.	" "	4 24	9.52	13.76	86.24	0.65
" " " . .	5 years.	6 months.	Devon.	" "	5.12	10.92	16.04	83.96	0.77
" " " . .	8 years.	8 months.	Mixed,	" "	4.05	10.68	14.73	85.27	0.74
Taunton (private farm), . . .	–	Mixture of	17 cows.	. . . .	4 79	10.15	14.94	85.06	0.64
" " " . . .	–	Samples representing different periods of the same milking.	Jersey.	"Fore milk,"	3.88	9.46	13.34	86.66	0.85
" " " . . .	–			"Middle,"	6.74	8.66	15 40	84.60	0.81
" " " . . .	–			"Strippings,"	8.12	9.01	17.13	82.87	0.82
From a "swill-milk" farm near Boston,	From two cows (one sick), . .			Brewers' grains and swill (chiefly tomato skins and cauliflower stumps).	3.55	9.65	13.20	86.80	–
" " "	From two cows, ...			" " " "	3 10	11.18	14.28	85.72	–
" " "	From one cow, ...			" " " "	3.17	10.42	13 59	86.41	–
" " "	From best cow, ...			" " " "	3.15	10.32	13.47	86.53	–
" " "	From one cow (very lean), . .			" " " "	3.31	9.68	12.99	87.01	–
" " "	Cow 20 years old (no teeth), .			" " " "	2.79	10.18	12.97	87.03	–

Average of 185 cows = 13.21 per cent. total solids.

SUMMARY.

	Number of samples passed.	Number analyzed above 13 per ct.	Total number above standard.	Number of samples below standard.	Total number of samples.
Boston,	15	11	26	43	69
Brockton,	11	14	25	12	37
Brookline,	9	2	11	6	17
Cambridge,	33	32	65	92	157
Chelsea,	42	12	54	46	100
Clinton,	9	8	17	8	25
Fall River,	33	28	61	40	101
Fitchburg,	11	1	12	4	16
Gloucester,	14	6	20	10	30
Haverhill,	5	16	21	11	32
Hyde Park,	3	12	15	16	31
Lawrence,	29	31	60	20	80
Lowell,	71	26	97	55	152
Lynn,	24	13	37	109	146
Malden,	16	3	19	20	39
New Bedford,	22	1	23	9	32
Newburyport,	18	26	44	10	54
Newton,	7	1	8	7	15
Provincetown,	-	5	5	5	10
Quincy,	-	-	-	7	7
Salem,	31	16	47	19	66
Somerville,	12	4	16	30	46
Taunton,	13	3	16	4	20
Waltham,	5	1	6	11	17
Woburn,	12	7	19	10	29
Worcester,	43	11	54	27	81
Other towns,	41	21	62	24	86
A and B Total,	529	311	840	655	1,495
C. From suspected producers,	40	25	65	71	136
D. Unknown sources,	-	7	7	23	30
E. Known purity,	-	48	48	50	98
Total (all classes),	569	391	960	799	1,759

Inspection of Milk.

I am frequently asked in court how it is possible for a dealer to know anything about the quality of the milk, which he may have for sale, without going to the expense of an analysis of each day's supply. While it would, of course, be impossible to obtain a knowledge of the exact proportions of solids and water each day without considerable expense and loss of time, it is easy, after a little practice with the necessary instruments, to obtain a very good idea of the quality of milk at no greater expense than a few minutes' time. The instruments required are a Lactometer or Lactodensimeter (Fig. 1), a Thermometer, and a Feser Lactoscope (Fig. 2).

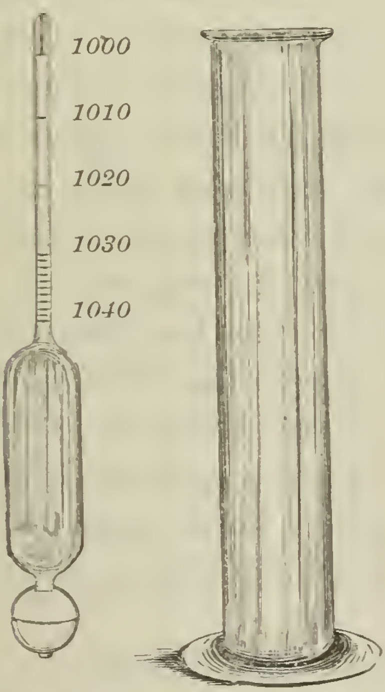


Fig. 1.

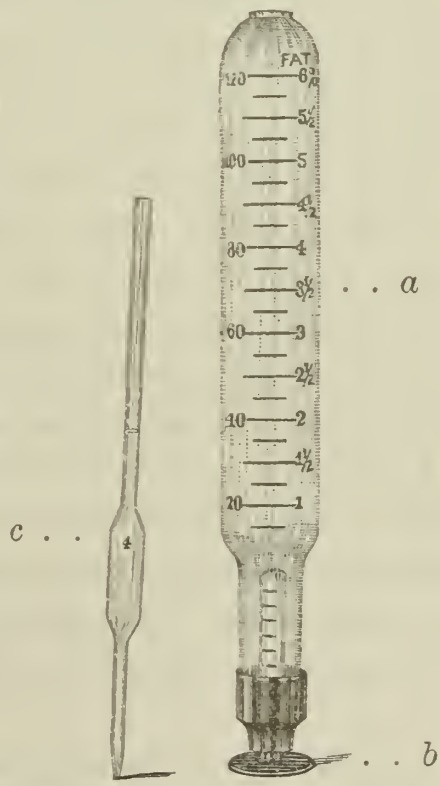


Fig. 2.

The Lactometer or Lactodensimeter is a very simple instrument, quite well known and understood, by means of which the specific gravity of milk is very quickly determined. The instrument is allowed to float in a cylinder of milk, and the depth to which it sinks, as recorded on the stem, is noted. As the instrument is graduated for milk at a certain

temperature, that of the milk to be examined must be observed by means of a thermometer. If the temperature be above the normal (60° Fahrenheit), the instrument will register more or less below the actual specific gravity; if below, on the other hand, it will register more or less above. The true specific gravity may be obtained by making corrections for temperature, or, better, by previously warming or cooling the sample to the normal temperature. Having ascertained the true specific gravity, which of itself alone indicates but little as to the quality of milk, the next point to determine is the approximate amount of fat. Before proceeding, however, to a description of the method for making this determination, a few observations on the specific gravity as an indicator of quality may not be out of place.

The specific gravity of pure milk is usually given as from 1,029 to 1,033, that of skimmed milk is higher, and that of watered milk lower. A milk which has been skimmed may, by the judicious admixture of a certain quantity of water, be brought down to the normal specific gravity. Therefore, a milk which at the normal temperature has a specific gravity falling within normal limits may be a pure milk, or a milk which has been both skimmed and watered, or a milk which originally had a specific gravity near the upper normal limit and to which a small percentage of water has been added.

A specific gravity materially higher than 1,033 indicates, usually, that the sample has been skimmed or partially skimmed, or, what is the same thing, a mixture of skimmed and whole milk. A specific gravity lower than 1,029 indicates, usually, a watered milk or a milk which is quite rich in fat.

A knowledge of the approximate amount of fat in a sample is, therefore, of great assistance in judging of its quality. This knowledge can be very easily obtained by means of the Feser Lactoscope (Fig. 2). This instrument consists of a glass cylinder (a) into the base of which is fixed a smaller cylinder of white glass closed at the top (b). Upon the latter cylinder are a number of horizontal black lines. The larger cylinder is graduated up to the top with lines and figures indicating the percentages of fat. The principle of the

instrument is based upon the fact that the richer the milk the greater the amount of water required to reduce its opacity to a fixed point, which opacity depends mainly on the fat globules. To use the instrument, the pipette (Fig. 2c), which is graduated to 4 cubic centimeters, is filled up to the mark (by suction), and the contents are allowed to flow into the cylinder through the orifice at the top. Water is now added, little by little, with frequent shaking or inversion of the cylinder, until the black lines on the white glass can be discerned through the liquid. The level of the liquid is then compared with the graduations of the scale and the corresponding percentage of fat noted.

Having ascertained the correct specific gravity and the approximate amount of fat it is a simple matter to form a tolerably correct opinion of the quality of the milk. If, for instance, we have a specific gravity within normal limits, and approximately 3.25 per cent. of fat, we may feel tolerably sure that the milk is of good quality. A normal specific gravity with 1 to $2\frac{1}{2}$ per cent. of fat would indicate poor quality. A specific gravity of 1.025 or thereabouts with perhaps 3 per cent. of fat, would indicate watering, while with say $4\frac{1}{2}$ to $5\frac{1}{2}$ per cent. of fat it would indicate richness in fat. A specific gravity of 1.025 with $1\frac{1}{2}$ or 2 per cent. would indicate very poor quality. Thus it may be seen that dealers who wish to buy and sell milk of good quality only, can protect themselves from dishonest sellers by the intelligent use of these very simple instruments. Their cost is not very great and the time required for their use on any sample need never be more than five minutes. A very excellent case of instruments containing a Lactodensimeter with cylinder to hold the milk, a Thermometer and a Feser Lactoscope with pipette, can be obtained for considerably less than ten dollars.

WESTERN MASSACHUSETTS.

The following report embraces the results of the analysis and inspection of milk obtained in the four western counties of the State. The samples were submitted to analysis at the Massachusetts Agricultural College under the direction of Prof. Charles A. Goessmann. Collections were made in eleven cities and townsin the western part of the State, the report covering the period from March 31, 1884 to March 31, 1885.

The whole number of samples obtained was one hundred and sixty-three. Of this number 112 were analyzed, and fifty-one were inspected, and found to conform to the legal requirement. Two samples were undoubtedly taken from the tops of cans, and gave the following results: —

Fat, ...	7.01	Total solids, . .	16.81
"	7.24	" " . .	16.68

Of those which did not conform to the standard, two were found to have between 10 and 11 per cent. of solids, 14 had between 11 and 12 per cent., 36 had between 12 and 13 per cent., and the remaining 109 were above the standard.

These samples were obtained in the following cities and towns: — Springfield, Holyoke, Northampton, Pittsfield, Greenfield, Chicopee, North Adams, West Springfield, Amherst, and Palmer.

Inspections were made of shops and wagons, about an equal number of each being represented.

Springfield.

Number of samples,	. . . .	39
" above standard,	. . . .	27
" below standard,	. . . .	12
Lowest,	. . . .	10.30

Inspector's Number.	Result of Analysis.					
	Temperature.	Specific Gravity.	Fat.	Solids, not Fat	Total Solids.	Water.
	C. 20	1.0296	3.90	–	12.44	87.56
	20	1.0305	3.24	–	12 01	87.99
	20	1.0296	3.45	–	11.77	88.23
	15	1.0330	2.58	–	11.60	88.40
	14	1.0335	4.18	–	13.87	86.19
	15	1.0305	3.83	–	12.41	87.59
	15	1.0335	1.38	–	0.30	89.70
	14	1.0340	4.89	–	14.24	85.76
	15	1.0325	3.54	–	12.80	87.20
	20	1.0296	4.33	–	13 12	86.88
	24	1.0290	4.16	–	12.78	87.22
	20	1.0278	3.52	–	11.65	88.35
	15	1.0350	3.88	–	13.88	86.12
	15	1.0338	4 90	–	14.31	85.69
	15	1.0348	4.65	–	14.10	85.90
	–	1.0350	3.93	–	13.66	86.34
	15	1.0348	5.49	–	15.13	84.87
2011, ...	3	1.035	5.53	–	15.08	84.92
2013, ...	2.8	1.0240	3.50	–	11.39	88.61
2017, ...	3.5	1.035	4.56	–	13.91	86.09
2029, ...	4.2	1.0332	3.74	–	12.30	87.70
2033, ...	5	1.0350	4.23	–	13.88	86.12
2039, ...	3.6	1.0388	4.66	–	13.84	86.16
2907, ...	11	1.0332	3.38	8.95	12.33	87.67
2909, ...	11	1.0332	3.83	9.29	13.12	86.88
2915, ...	11	1.0332	4.78	9.57	14.35	85.65
2917, ...	11	1.0332	4.90	9.41	14.31	85.69

Holyoke.

Number of samples, ... 28
" above standard, ... 19
" below standard, ... 9
Lowest, ... 10.84

Inspector's Number.	Result of Analysis.					
	Temperature.	Specific Gravity.	Fat.	Solids, not Fat.	Total Solids.	Water.
	C. 22	1.0295	4.23	–	13.91	86.09
	18	1.0325	2.89	–	10.84	89.16
	18	1.0325	2.25	–	12.08	87.92
	19	1.0320	3.55	–	12.87	87.13
	–	–	2.96	–	12.63	87.37
	20	1.0320	2.88	–	12.29	87.71
	20	1.0302	3.60	–	12.49	87.51
	23	1.029	3.32	–	11.69	88.31
	23	1.0314	2.15	–	13.08	86.92
2637, ...	12	1.0332	3.41	9.09	12.50	87.50
2641, ...	13	1.0342	3.89	9.34	13.23	86.77
2619, ...	12	1.0335	4.25	9.47	13.72	86.28
2623, ...	13	1.0320	5.12	8.99	14.11	85.89
2631, ...	12	1.0332	3.85	8.72	12.57	87.43
2633, ...	12	1.0336	4.79	9.16	13.95	86.05
	22	1.0290	4.81	–	15.72	84.28
	22	1.0302	4.29	–	13.39	86.61
	24	1.0314	4.73	–	13.97	86.03

Chicopee.

Number of samples, ... 22
" above standard, ... 14
" below standard, ... 8
Lowest, ... 11.83

CHICOPEE — *Continued.*

Inspector's Number.	Result of Analysis.					
	Temperature.	Specific Gravity.	Fat.	Solids, not Fat.	Total Solids.	Water.
	C. 14	1.0320	3.85	-	12.82	87.18
	14	1.033	4.17	-	13.39	86.61
	13	1.0350	4.83	-	14.40	85.60
	12	1.0355	4.12	-	13.69	86.31
	11	1.0350	4.08	-	13.25	86.75
	22	1.029	4.26	-	11.95	88.05
	22	1.0315	2.93	-	12.16	87.84
	22	1.0295	2.40	-	11.83	88.17
	22	1.0290	5.21	-	12.94	87.16
	16	1 0355	4.15	-	12.20	87.80
	16½	1.0302	2.70	-	12.63	87.37
	18	1.0308	4.17	-	13.09	86.91
2893, ...	12	1.0332	3.89	9.52	13.41	86.59
2903, ...	11	1.0314	3.68	8.73	12.41	87.59

NORTH ADAMS.

Number of samples, ... 15
" above standard, ... 13
" below standard, ... 2
Lowest, ... 11.76

Inspector's Number.	Result of Analysis.				
	Temperature.	Specific Gravity.	Fat.	Total Solids.	Water.
	C. 15	1.0248	4.22	11.76	88.24
	15	1.0332	4.02	13.80	86.20
	16	1.0293	4.17	13.16	86.84
	15	1.0332	3.60	13.84	86.16
	13	1.0332	3.95	13.62	86.38
2383, ...	8	1.0350	4.12	13.85	86.15
2385, ...	9	1.0350	4.14	13.97	86.03
2389, ...	9	1.0338	2.96	12.04	87.96
2395, ...	10	1.0350	4.10	13.88	87.12
2397, ...	10	1.0388	4.04	13.19	86.81
2401, ...	10	1.0350	5.79	14.37	85.63

AMHERST.

Number of samples,	4
" above standard,	1
" below standard,	3
Lowest,	12.12

RESULT OF ANALYSIS.

Temperature.	Specific Gravity.	Fat.	Total Solids.	Water.
C. 15	1.0314	3.98	12.80	87.20
18	1.0314	3 34	12.12	87.88
18	1.0314	3.24	12.13	87.87
18	1.0320	3.79	13.06	86.94

NORTHAMPTON.

Number of samples,	6
" above standard,	6
" below standard,	0
Lowest,	13.32

RESULT OF ANALYSIS.

Temperature.	Specific Gravity.	Fat.	Total Solids.	Water.
C. 8	1.0356	3.92	13.32	86.68
10	1.0356	4.25	14.16	95.84
10	1.0356	5.28	14.59	85.41
10	1,0338	4.55	14.54	85.46
11	1.0338	4.64	14.37	85.63
10	1.0356	4.01	13.56	86.44

Pittsfield.

Number of samples,	5
" above standard,	1
" below standard,	4
Lowest,	12.70

Result of Analysis.

Temperature.	Specific Gravity.	Fat.	Total Solids.	Water.
C. 18	1.0318	3.59	12.71	87.29
17	1.032	3.61	12.79	87.21
17	1.0326	3.62	12.70	87.30
18	1.0320	3.68	13.21	86.79
18	1.0302	4.00	12.70	87.30

Greenfield.

Number of samples,	5
" above standard,	4
" below standard,	1
Lowest,	12.82

Result of Analysis.

Temperature.	Specific Gravity.	Fat.	Total Solids.	Water.
C. 16	1.032	4.89	14.29	85.71
17	1.032	3.92	13.25	86.75
17	1.0326	3.48	12.82	87.18
17	1.0332	4.51	14.69	85.31
17	1.030	4.15	13.30	86.70

Ashleyville, Palmer, West Springfield.

Number of samples,	6
" above standard,	2
" below standard,	4
Lowest,	11.83

Result of Analysis.

Temperature.	Specific Gravity.	Fat.	Total Solids.	Water.
C. 17	1.0290	3.35	11.90	88.10
17	1.0325	3.99	13.49	86.51
22	1.0295	2.40	11.83	88.17
17	1.0302	4.14	12.80	87.20
16½	1.0318	3.80	12.59	87.41
17	1.0325	3.99	13.49	86.51

In addition to this work, an analysis of milk obtained at the farms of the two State institutions in this district was also made, with the following result: —

REPORT OF PROF. C. A. GOESSMANN, Analyst.

(SAMPLES OF KNOWN PURITY.)

STATE PRIMARY SCHOOL AT MONSON.

*Time of Milking.	Age of Cow.	Time since Calving.	Breed.	Character of Feed.	Results of Analysis. Specific Gravity.	Fat.	Total Solids.	Water.	
May 30 (morning),	6 years.	Oct., 1883,	Half Holstein,	Grass, meal,	1.0315	3.56	13.29	86.70	Temp , 22° C.
" "	10 "	April, 1884,	Durham and Ayrshire,	Shorts with hay,	1.0310	5.72	12.24	87.76	" 22° C.
" "	13 "	May, 1884,	Ayrshire,	" "	1.0310	4.92	11.66	88.34	" 21° C.
" "	2 "	Jan. 1884,	"	" "	1.0300	2.57	13.04	86.96	" 19° C.
" "	5 "	May, 1884,	"	" "	1.0315	3 14	14.63	85.37	" 20° C.
" "	4 "	May, 1884,	"	" "	1.0320	4.01	13.38	86.62	" 20° C.
June 6 (morning),	6 "	Oct., 1883,	Half Holstein,	Grass, shorts with hay,	1.0290	4 06	13.30	86 70	" 25° C.
" "	10 "	April, 1884,	Durham and Ayrshire,	" " "	1.0278	2.83	11.14	88.86	" 25° C.
" "	13 "	May, 1884,	Ayrshire,	" " "	1.0290	2.86	11.53	88.47	" 22° C.
" "	2 "	Jan., 1884,	"	" " "	1.0290	3.58	12.68	87.32	" 27° C.
" "	5 "	May, 1884,	"	" " "	1.0295	4.00	13 40	86.60	" 27° C.
" "	4 "	May, 1884,	"	" " "	1.0295	3.22	12.21	87.79	" 27° C.
Average,							12.71		

* Milked in the presence of W. S. Smith and Col. Tufts.

STATE LUNATIC HOSPITAL, NORTHAMPTON.

Time of Milking.	Age of Cow.	Time since Calving.	Breed.	Character of Feed.	Results of Analysis.				
					Specific Gravity.	Fat.	Total Solids.	Water.	
Aug. 8 (evening),	8 years.	Jan. 23, 1884,	Grade Durham,	Grass and corn fodder,	1.0296	3.67	12.36	87.64	Temp., 18° C.
" "	9 "	June 26, 1884,	" "	2 qts. meal, grass and corn fodder,	1.0300	3.27	11.73	88.27	" 20° C.
" "	8 "	June 1, 1884,	" "	Grass and corn fodder,	1.0302	2.30	10.72	89.28	" 19° C.
" "	9 "	Feb. 27, 1884,	" "	4 qts. meal, grass and corn fodder,	1.0295	3.33	11.80	88.20	" 19° C.
" "	7 "	Jan. 24, 1884,	Devon,	Grass and corn fodder,	1.0305	3.89	13.09	86.91	" 19° C.
" "	7 "	May 8, 1884,	Grade Durham,	Grass and corn fodder,	1.0295	3.12	11.42	88.58	" 19° C.
Aug. 15, 1884 (evening),	10 "	June 22, 1884,	" "	3 qts. meal, grass and corn fodder,	1.0296	3.15	11.86	88.14	" 21° C.
" " "	10 "	Dec. 17, 1884,	" "	4 qts. meal, grass and corn fodder,	1.0304	3.47	12.81	87.13	" 22° C.
" " "	10 "	March 25, 1884,	" "	3 qts. meal, pasture and corn fodder,	1.0290	3.51	12.31	87.69	" 20° C.
" " "	8 "	Jan. 8, 1884,	" "	Grass and corn fodder,	1.0296	4.21	13.25	86.75	" 23° C.
" " "	8 "	March 8, 1884,	" "	" " "	1.0278	3.61	12.08	87.92	" 23° C.
" " "	4 "	June 1, 1884,	Thoroughbred Durham,	3 qts. meal, grass and corn fodder,	1.0296	3.28	12.13	87.87	" 23.5° C.
Average,							12.13		
Samples taken from 4 to 8 cows,					1.0326	2.50	12.20	87.80	Temp., 15° C.
" " " without reference to breed,					1.0314	2.90	12.30	87.70	" 15° C.

C. A. GOESSMAN.

AMHERST, MASS., Oct. 1885.

REPORT OF THE ANALYST OF DRUGS.

PROF. BENNETT F. DAVENPORT, M. D.

REPORT OF THE ANALYST OF DRUGS,

Dr. Bennett F. Davenport.

To S. W. Abbott, M. D., *Health Officer of the Massachusetts State Board of Health, Lunacy and Charity.*

Sir: — I have the honor to make the following report upon the drugs examined by me during the year ending January 1, 1885.

I have received 621 samples of drugs, and have found that 285 of them, that is, 45.8 per cent., were not of the standard quality required by the statute, that is, did not conform to the requirements laid down in the last edition of the United States Pharmacopœia.

The different samples of drugs examined were comprised in the following groups.

Æther, 13 samples. All were of fairly standard quality.

Alcohol, 26 samples. All were of standard quality as to alcoholic strength, and of fair quality as to foreign organic impurities, although the United States Pharmacopœial tests for their absence appears to be rather too severe for an alcohol which has once been stored in barrels, as is usual with the commercial article.

Alum, 20 samples. All were of the standard quality except 8, and these were by reason of being not the potash, but the ammonia salt, of which they were good samples.

Ammonium Bromide, 9 samples. All were of standard quality.

Ammonium Nitrate, 1 sample, which was of good quality.

Argenti Nitrate, 14 samples, in crystals and fused. All were good.

Bismuth Subcarbonate and Nitrate, 34 samples. Of these 24 contained an excess of arsenic left in them.

Calcium Carbonate Precipitate, 12 samples. Of these 2 were not of standard quality, but were common chalk or whiting.

Carbo Animalis, 13 samples. Of these 9 were not of standard quality, 5 being samples of the crude drug, while 4 were wood charcoal. When such a drug as this, or aloes, chloroform, or any other drug of which the pharmacopœia mentions a crude as well as a purified form, is called for by a physician's recipe, it may be for internal use, the purified alone should be dispensed unless the crude is specified. It is to be noted that the pharmacopœia in mentioning the preparations in which the crude drug is to be used specifies principally the preparation of the purified, and then such others as are for external use. It never mentions the crude to be used in a preparation for internal administration where there is also a purified form of the drug included in its list.

Cerium Oxalate, 7 samples. All of good quality.

Chloral, 8 samples. All of fair quality.

Copper Salts, 5 samples. All of standard quality.

Ferrum and its preparations, 21 samples. Only three of these were not up to standard quality.

Glycerine, 7 samples. Of these 2 had a small excess of water.

Hydrargyrum Salts, 9 samples. All of proper quality.

Iodine Tinctures, 12 samples. Of these but 3 were of fairly standard quality in quantity of Iodine.

Iodoform, 2 samples. Both of proper quality.

Liquor Calcis, Ferri Chloridi, Potass. Arsenitis, and Sodæ Chloratæ, 7 samples. All of fairly standard quality.

Lithium Salts, 2 samples. Both of proper quality.

Magnesium Salts, 26 samples. All of fair standard quality.

Manganese Salts, 2 samples. Both of good quality.

Potassium Bromide, 7 samples. All contained excess of alkali, but were of fairly standard quality otherwise.

Potassium Iodide, 8 samples. All but one had an excess alkali, and all but one had a slight excess of Chloride.

Potassium Bitartrate, or Cream of Tartar, 17 samples. Of these 11 had an excess of Lime Salts, and 8 an excess of Chloride.

Potassium Acetate, Carbonate, Chlorate, and Sulphuret, 7 samples. All of good quality.

Plumbic Acetate and Iodide, 4 samples. All of proper quality.

Spirit Ætheris Comp., 19 samples. But 2 contained any fairly proper amount of the ethereal oil, and one other a slight amount of this the most essential and expensive ingredient in this preparation. That which is usually sold for this preparation, which is commonly known as Hoffmann's Anodyne, is really only a by-product from the rectification of crude ether. It is obtained after the ether of proper quality has all been distilled over; that which comes off after that consists of a mixture of ether and alcohol impregnated with a very little ethereal oil. This mixture is then further prepared by being variously modified by the addition of alcohol, ether, or water, and of fixed oils so as to imitate in taste, smell, opalescence, gravity, and other physicial qualities a standard sample kept for this purpose. The usual reason assigned for this fraud is the costliness of the true ethereal oil, for which it takes about fifty parts of alcohol to make one of the oil. It is therefore necessarily an expensive preparation, yet this hardly justifies the substitution of a cheaper, but nearly worthless article. The true preparation is most easily told from the false by the fact that although it will, even when old, give hardly any precipitation with barium chloride, yet its residue left after ignition will give a heavy precipitation. This great difference in reaction is not produced by ignition of the imitation preparation.

Spirit Ætheris Nitrosi, 23 samples. A very reliable method of assay is the one adopted in the new edition of the British Pharmacopœia, based upon the volume of nitric oxide gas which the sample will evolve in the presence of potassium iodide and dilute sulphuric acid. With these each part by weight of the gas evolved, shows the presence of $2\frac{1}{2}$ parts of ethyl nitrite. Spirit prepared as directed by the Pharmacopœia when assayed by this more reliable method, will be found to contain about 2.1 per cent. of ethyl nitrite. This method, using some modification of Lunge's Nitrometer, admits of very rapid execution with uniform results. Tested by this method, 6 of the samples contained between 2 and

3 per cent. of ethyl nitrite, 14 had between 1 and 2 per cent., while 3 fell below 1 per cent.

Opium, Powdered, 5 samples. These contained 10.80, 11.10, 11.62, 10.74, and 10.22 per cent. of morphine, and thus none of them reached the minimum standard of 12 per cent. of morphine.

Opium Tinctures, 51 samples. These contained 0.91, 0.74, 1.16, 0.87, 0.80, 1.12, 1.07, 1.06, 1.26, 1.21, 1.04, 0.88, 0.60, 0.89, 0.51, 0.70, 1.04, 0.84, 0.87, 1.27, 1.12, 1.32, 0.98, 1.12, 1.15, 0.89, 1.24, 1.20, 0.77, 0.89, 0.91, 0.90, 0.88, 0.67, 0.83, 1.23, 1.32, 1.04, 1.35, 1.28, 1.04, 0.62, 1.03, 0.91, 1.08, 1.05, 0.75, 1.05, 1.19, 0.82, 0.58 per cent. of morphine. Thus 10 reached the minimum standard of 1.20 per cent. of morphine, and 7 others came within 10 per cent. of it. This last was about the strength of the old standard before it was changed by the 1880 revision of the United States Pharmacopœia.

Opium Alkaloids as Morphine, 2 samples. Both good.

Cinchona Bark, Powdered, 11 samples. These contained 2.72, 9.42, 2.04, 5.15, 1.78, 5.66, 1.99, 1.44, 5.28, 0.69, and 2.22 per cent. of total alkaloids. Thus but 4 contained the not less than 3 per cent. required by the standard.

Cinchona Alkaloids, 13 samples. Were all of standard quality except in 2 cases where the sulphate was substituted for the free alkaloid.

Quinine Pills. I have examined 22 different original packages of the various makers of coated pills which were offered for sale by the wholesale druggists in this city. They were bought in the original sealed packages, the first 12 of them about the beginning of the year, and the other 10 about the end of the year, 1884. In the second collection were the 9 kinds still offered for sale here — the other 3 were not to be obtained here; while one was of a new make recently offered in this market. The following was the method of assay employed: Taking 10 or 20 of the pills, according as it was a 2 or 1 grain pill, they were placed in a small porcelain capsule and covered with cold distilled water. They were allowed to macerate until, by the small glass rod in each capsule, they could be broken up and stirred into a uniform paste, as much more of the water was then added, and then

a large excess of a freshly slacked lime. These were thoroughly mixed together into a thin flowing mass, and then made perfectly dry in a water oven. The dried mass, when thoroughly removed from the capsule and rod, and rubbed into a very fine powder in a small porcelain mortar, was then transferred to the inner tube, closed at the bottom by filter paper tied over it, of a glass continuous repercolating apparatus. All this transferring from capsule to the percolator and the powdering was done over a black glazed paper, that no flying particle could possibly be lost. The capsule, rod, mortar and pestle were rinsed out with stronger ether, which was then poured upon the mass in the percolator, until there was nothing with a bitter taste left upon any of them. The flask of the percolator was then supplied with the further proper amount of stronger ether of the pharmacopœial quality. The percolation was then run for 48 hours, or until some drops of the ether from the percolate would leave no visible residue or bitterness when evaporated upon the surface of a dark, stained glass, and the powdered mass no longer had a bitter taste. Six hours of percolation would usually practically exhaust the mass, yet it was run at least 48 hours. All the residues have been preserved. The ethereal percolate was then transferred from the flask to a weighed beaker, the flask being rinsed out until there was no residue or bitterness left in it. The contents of the beaker, when fully evaporated and dried in a boiling water oven and cooled in a dessicator, was then quickly weighed upon being taken out. Each of the 22 samples was thus assayed three separate times. The residues thus obtained furnished a large enough quantity of the anhydrous alkaloid to test it for identity and purity as quinine by the pharmacopœial methods.

Twenty grains of Quinine Sulphate with the pharmacopœial quantity of 7 molecules of water of crystallization would yield 0.963 grammes of anhydrous quinine, while with the allowed 8 molecules it should yield 0.943 grammes. The pills of the 22 samples of the following makers did yield by the above method of assay the following amounts of anhydrous quinine, the percentages being calculated upon the largest yield of the three successive assays. The alkaloid obtained stood the test for identity and for purity as quinine as will be noted below.

Samples of the First Collection.

1. Bullock & Crenshaw of Philadelphia. Yielded 0.882 grms. of anhydrous quinine, or 93.5 per cent. the proper amount. The other 2 assays yielded 0.870 and 0.833 grms. It was of the standard quality as quinine.

2. McKesson & Robbins of New York City. Yielded 0.817 grms. or 86.6 per cent. It was of the standard quality. The other 2 assays gave 0.795 and 0.790 grms.

3. Parke Davis & Co. of Detroit, Mich. Yielded 0.880 grms., or 93.3 per cent. This was of proper quality. The 2 other assays gave 0.837 and 0.823 grms.

4. W. H. Schieffelin & Co. of New York City. Yielded 0.885 grms., or 93.8 per cent This was of proper quality. The 2 other assays gave 0.865 and 0.863 grms.

5. Henry Thayer & Co of Cambridgeport, Mass. Yielded 1.015 grms., or 107.6 per cent. This was of proper quality. The 2 other assays gave 0.970 and 0.892 grms.

6. Tilden & Co. of New Lebanon, N. Y. Yielded 0.799 grms., or 84.7 per cent This was not of pharmacopœial quality. The 2 other assays gave 0.770 and 0.740 grms.

7. Wm. R. Warner & Co. of Philadelphia. Yielded 0.885 grms., or 93.8 per cent. This of standard quality. The 2 other assays gave 0 865 and 0.839 grms.

8. John Wyeth & Bros. of Philadelphia. Yielded 0.985 grms., or 104.4 per cent. This of standard quality. The 2 other assays gave 0 947 and 0.945 grms.

9. Hance Bros. & White of Philadelphia. Yielded 0.915 grms., or 97.0 per cent. This of proper quality. The 2 other assays gave 0.905 and 0.872 grms.

10. P. J. Noyes of Lancaster, N. H. Yielded 0.915, or 97.0 per cent. This of standard quality. The 2 other assays gave 0.910 and 0.830 grms.

11. Mackeown, Bower, Ellis & Co. of Philadelphia. Yielded 0.643 grms., or 68.1 per cent. This not of pharmacopœial quality. The 2 other assays gave 0.642 and 0.633 grms.

12. Keasby & Mattison of Philadelphia. Yielded 0.882 grms., or 93.5 per cent. This of proper quality. The 2 other assays gave 0.885 and 0.850 grms

Samples of the Second Collection.

13. McKesson & Robbins of New York. Yielded 0.918 grms., or 97.3 per cent. This of proper quality. The 2 other assays yielded 0.914 and 0.894 grms.

14. W. H. Schieffelin & Co. of New York. Yielded 0.950 grms., or 100.7 per cent. This of standard quality. The 2 other assays gave 0.944 and 0.942 grms.

15. Tilden & Co. of New Lebanon, N. Y. Yielded 0.844 grms., or 89.5 per cent. This not of pharmacopœial quality. The 2 other assays gave 0.833 and 0.830 grms.

16. Parke Davis & Co. of Detroit, Mich. Yielded 0.940 grms., or 99.6 per cent. This of proper quality. The 2 other assays gave 0.938 and 0.933 grms.

17. Bullock & Crenshaw of Philadelphia. Yielded 0.924 grms., or 97.9 per cent. This of proper quality. The 2 other assays gave 0.886 and 0.844 grms.

18. Henry Thayer of Cambridgeport, Mass. Yielded 0.722 grms., or 76.5 per cent. This of proper quality. The 2 other assays gave 0.718 and 0.680 grms.

19. Hance Bros. & White of Philadelphia. Yielded 0.916 grms., or 97.1 per cent. This of proper quality. The 2 other assays gave 0.913 and 0.900 grms.

20. Kelley & Durkee of Boston, Mass. Yielded 0.986 grms., or 104.5 per cent. This of standard quality. The 2 other assays gave 0.980 and 0.978 grms.

21. John Wyeth & Bros. of Philadelphia. Yielded 0.948 grms., or 100.5 per cent. This of proper quality. The 2 other assays gave 0.941 and 0.936 grms.

22. Wm R. Warner & Co. of Philadelphia. Yielded 0.954 grms., or 101.1 per cent. This of standard quality. The 2 other assays gave 0.946 and 0.938 grms.

Thus, with but two exceptions out of the 9 collected for the second time later in the year, the later collected samples were better than the earlier. It was because I had been informed by one of the largest manufacturers, that much greater care was being generally taken in the preparation of quinine pills, that caused me to suggest that a second collection be made in order to ascertain if it was really the fact. That it was a fact is shown not only by the usually larger amount of alkaloid obtained, but also by the more uniform amounts obtained in the second set of three successive assays, the averaged maximum difference being only about half as much.

Iron and Quinine Citrate, in scales, 15 samples. These contained 12.0, 11.87, 11.3, 8.68, 8.53, 11,42, 9.0, 10.6, 8.83, 11.5, 10.98, 11.95, 9.68, 9.88, 10.1 of alkaloid. Thus but one came up to the standard of 12 per cent., and only 6 others came to within 10 per cent. of it. Whether the alkaloid was of the standard quality the size of the sample did not allow the pharmacopœia tests to be made use of to determine.

Iron and Quinine Citrate Liquor, the 3 samples, yielded

1.83, 0.93 and 6.95 per cent. of alkaloid, while the standard is 6 per cent.

Ferri and Strychnine Citrate, 1 sample, and that of proper quality.

Elaterin, 1 sample, which was of inferior quality.

Chloroform, 15 samples, of which only 1 was of the standard quality of the purified form; all the others were the crude drug.

Sugar of Milk, 5 samples, were all of standard quality.

Aloes, powered, 12 samples, of which but 5 were of the proper quality as the purified drug. The rest were crude drugs.

Arnica Flowers, 3 samples, were all of good quality.

Cinnamon, 4 samples, were all of proper quality.

Cochineal, 6 samples, of which 2 were of proper quality, while the others were more or less loaded with some heavy foreign powder.

Copaiba, 4 samples, of which 2 were of standard quality.

Creasotum, 5 samples, of which 2 were of proper quality, while the others were crude carbolic acid.

Crocus, or Saffron, 5 samples, of which none were the true Saffron, but all were Safflower.

Cubebs, 5 samples, were all of standard quality.

Digitalis, 5 samples, were all of good quality.

Ergot, 4 samples, of which 2 were of poor damaged quality.

Glycyrrhiza, 5 samples, all of good quality.

Gossypium, 5 samples all of standard quality.

Honey, 1 sample, which was of standard quality.

Hyoscyamus, 2 samples, of which 1 was of a damaged quality.

Jalap, 33 samples. These yielded the following percentages of total alcoholic extract, and of that which was soluble in ether: 15.01 and 2.08, 11.92 and 1.49, 9.68 and 1.53, 9.65 and 1.89, 11.1 and 2.22, 15.19 and 2.11, 2.22 and 0.49, 9.55 and 1.37, 6.61 and 1.37, 10.95 and 0.79, 9.65 and 1.59, 10.27 and 1.59, 12.17 and 1.49, 12.12 and 2.62, 13.18 and 1.65, 8.35 and 1.55, 7.49 and 0.56, 10.15 and 1.02, 2.9 and 0.00, 12·07 and 2.17, 12.40 and 2.47, 5.94 and 0.00, 12.56 and 2.49, 16.37 and 2.25, 13.76 and

2.05, 3.55 and 0.58, 10.07 and 2.17, 10.43 and 0.75, 8.64 and 1.61, 15.35 and 1.05, 12.47 and 2.62, 10.19 and 1.34, 11.18 and 1.34. Thus 12 of the samples were of standard quality.

Kino, 2 samples, both of good quality.

Linseed, 2 samples both of good quality.

Mace, 3 samples, of which 2 were of standard quality, and the other contained some flour.

Oils, essential and fixed, 8 samples, of which 7 were of proper quality.

Resins, 6 samples, of which 5 were of standard quality.

Tinctures, 2 samples, both of standard quality.

Cloves, 12 samples, of which none were of standard quality; all were either deficient in the oil, or had foreign substance present.

Ipecac 3 samples, of which 2 were of proper quality, while the other contained wheat flour.

Mustard, 2 samples, both of standard quality.

Pepper, 3 samples, of which only 1 did not contain some wheat starch substance.

THE

WEEKLY MORTALITY REPORTS

OF

MASSACHUSETTS CITIES AND TOWNS.

THE

WEEKLY MORTALITY REPORTS OF MASSACHUSETTS CITIES AND TOWNS.

The reports published in the last supplement of the Board (p. 63) embraced the statistics of mortality of the cities and large towns of the State, about thirty-five in number, with a population of a little more than one million inhabitants, for about ten months; and near the close of the year, in consequence of a special appeal, about one hundred municipalities were induced to forward weekly reports to the Board, representing about 1,265,000 people. The reports of these one hundred towns have been continued throughout 1884, and reports might be obtained from all, if the registration laws were everywhere complied with; but in the smaller towns, where the average number of deaths is less than one per week, certificates of death are not unfrequently delayed for several weeks or months, and occasionally are returned all together at the close of the year, a plan which must necessarily be inaccurate and unreliable. The reports received from these cities and towns are made up weekly by the Health Department, and a copy sent to the town clerk of every city and town in the State. It would add very much to their value if every town, even the smallest, would contribute to the reports.

The Registration Reports issued annually by the Secretary of State are full and complete; and, in consequence of the length of time since they were initiated (1842), they form a series of great statistical and sanitary value.

The weekly reports of the Health Department vary somewhat from the registration reports in the following particulars: —

1. The sum of the returns does not correspond with the exact calendar year, each report from a municipality being made up to Saturday noon of the week whose deaths are reported.

2. In consequence of the greater fatality in the cities and large towns, the death rate as calculated in this report, is usually larger than that of the State.

The following is a sample of the card used for reporting diseases. A sufficient number of these cards are sent to the registrar, town clerk or other person reporting to the Board, in each city or town; and one is filled and returned at the close of each week to the office of the Health Department.

REPORT OF DEATHS in ________________ for the Week ending Saturday NOON, ________________ 1885.

[Please note any mortality from UNUSUAL causes not specified in this Blank, and the PREVALENCE, TO A GREAT EXTENT, OF ANY DISEASE.]

[Under the head of CASES OF SMALL-POX, please put the number before the word CASES, and not after it.]

DISEASES.	DEATHS.
Small-Pox, ...	
________ CASES OF SMALL-POX, . .	
Measles, ...	
Scarlet Fever or Scarlatina, ...	
Cerebro-spinal Meningitis, ...	
Diphtheria and Croup, ...	
Whooping Cough, ...	
Erysipelas, ...	
Typhoid Fever, ...	
Puerperal Fever, ...	
____________ Fever, ...	
____________ Fever, ...	
Diarrhœal Diseases, ...	
Consumption or Phthisis, ...	
Acute Lung Diseases, ...	
______________________	
______________________	
DEATHS UNDER 5, ...	
Deaths from ALL CAUSES, not including Still-Births, ...	
Still-Births, ...	

REMARKS.

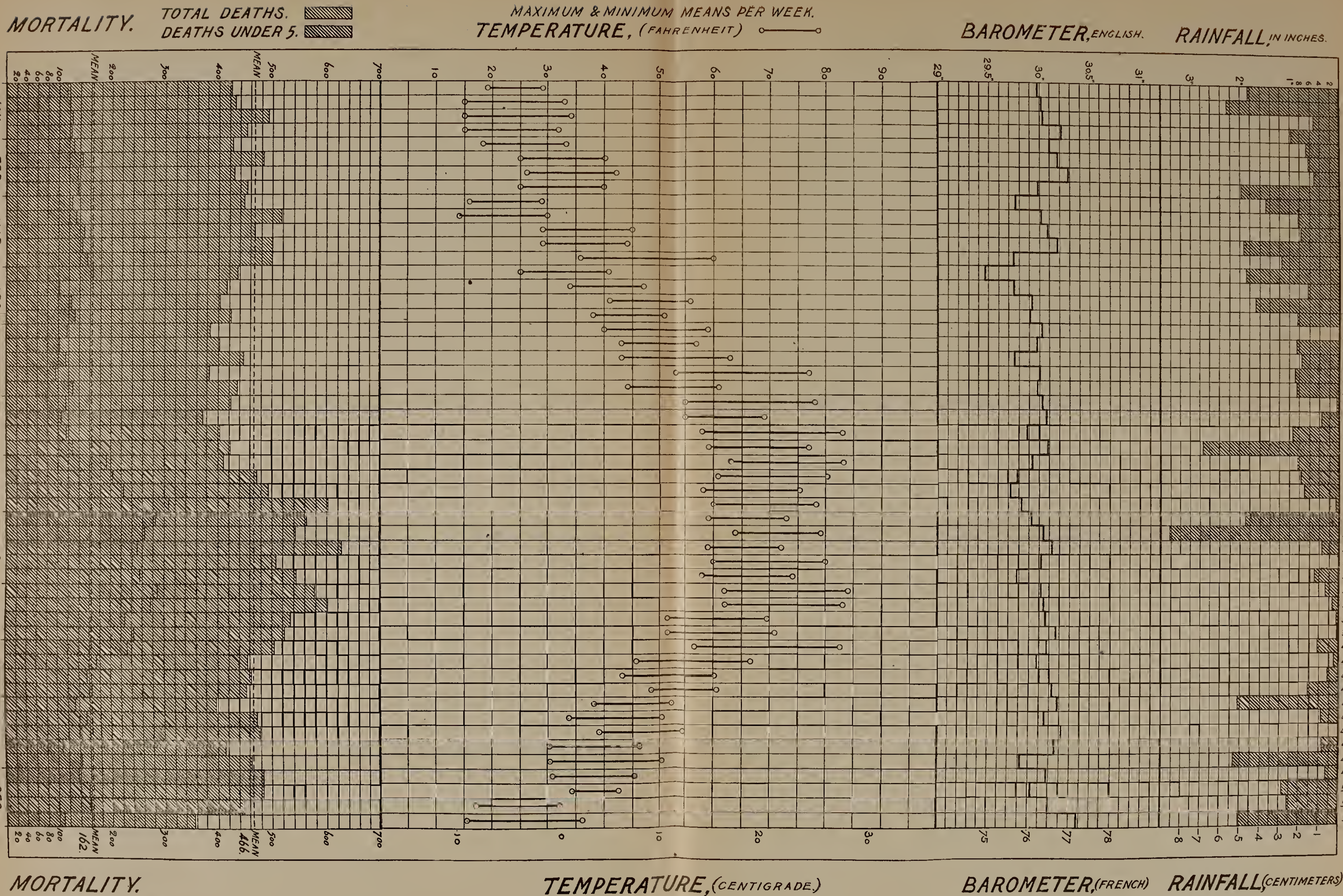


Chart showing the total weekly mortality from population as reported; also the mortality of children under 5 years of age, the mean range of temperature for each week, the mean height of barometer and the total weekly rainfall at Boston.

In general, the results of the following statistics, with reference to Massachusetts, show that the year 1884 was, like 1883, a year remarkably free from epidemics, as will be seen by reference to the following tables. The chief exception to this general statement is found in the greater prevalence of whooping-cough, as indicated by its fatality in the months of July, August and September. On the other hand, measles, which in 1883 was quite prevalent and severe in the early summer season, prevailed but slightly throughout 1884.

The data embraced in this report are as follows: —

Average height of barometer for each week.
Mean of daily maximum temperature.
Mean of daily minimum temperature.
Rainfall expressed in inches.
Humidity.
Total deaths for each week reported.
Deaths of children under 5 years.
Deaths from infectious diseases.

- Consumption.
- Acute Lung Diseases.
- Typhoid Fever.
- Diarrhœal Diseases.
- Scarlet Fever.
- Measles.
- Diphtheria and Croup.
- Puerperal Fever.
- Whooping-cough.
- Malarial Fever.
- Small-pox.
- Erysipelas

General Summary.

DATE.	Barometer.	Maximum Thermometer. Mean for ea. week.	Minimum Thermometer. Mean for ea. week.	Rain. — Inches.	Humidity. Mean for ea. week.	Total Deaths.	Deaths under 5.	Infectious Diseases.	Consumption.	Acute Lung Diseases.	Typhoid Fever.	Diarrhœal Diseases.	Scarlet Fever.	Measles.	Diphtheria and Croup.	Puerperal Fever.	Whooping Cough.	Malarial Fever.	Small-pox.	Erysipelas.	Death-rates.
1884.																					
January 5, . .	29.971	29.	19.	1.84	79.	422	116	67	77	62	10	8	9	–	22	2	–	1	–	4	18.00
" 12, . .	30 026	33.	15.	2.28	70.	430	120	71	71	60	8	9	10	–	30	2	3	–	–	5	17.41
" 19, . .	30.033	34.	15.	.53	65.	493	128	85	80	68	9	12	9	–	33	5	4	–	–	4	20.00
" **26**, . .	30 213	32.	15.	.98	76.	451	126	83	72	66	7	5	10	1	27	7	4	–	–	6	17.78
February 2, . .	30.104	33.3	18 3	.68	79.6	425	129	59	65	58	6	4	12	1	17	4	2	–	–	3	16 59
" 9, . .	30.172	40.3	25.	.62	89.7	482	144	77	84	58	11	7	7	1	26	4	6	1	–	2	19.26
" 16, . .	30 297	42.4	26.2	.51	81 6	429	137	61	72	87	2	12	9	–	28	–	1	–	–	1	16.28
" 23, . .	29.988	40.	25.	1 99	91.	454	138	53	58	72	8	4	2	–	22	2	3	–	1	–	16.72
March 1, . .	29.767	29.	16.	1.49	70.	449	126	65	74	61	5	7	10	2	23	5	4	–	–	2	18.00
" 8, . .	30.026	30.	14.	.81	80	518	134	65	92	88	2	11	6	–	24	6	1	–	–	2	20 31
" 15, . .	30.098	45.	29.	.78	79.	469	149	82	86	62	9	12	12	1	29	1	4	–	–	1	17.07
" 22, . .	30.179	44.	29.	1.91	71.	500	145	72	83	67	9	17	11	–	24	2	1	–	–	–	18.21
" 29, . .	29.748	60.	36.	1.18	78	500	152	58	93	87	6	6	5	–	16	4	–	–	–	6	2 .61
April 5, . .	29.463	41.	25.	1.86	81.	436	116	55	77	71	9	7	7	–	18	5	4	–	–	4	16 77
" 12, . .	29.758	47.	34.	.62	84.	414	101	51	68	55	11	8	8	–	13	3	1	1	–	1	16.00
" 19, . .	29.938	56.	41.	1.69	83.	402	125	45	52	66	7	1	4	–	22	1	4	–	–	3	16.60
" 26, . .	29.926	51.	38.	.82	82.	422	132	46	74	72	4	7	6	2	14	1	–	2	–	5	15.63
May 3, . .	30 041	59.	40.	–	73.	386	117	49	83	35	2	10	11	–	15	2	3	–	1	1	13.67
" 10, . .	29 973	57.	43.	.83	81.	401	101	51	58	41	7	5	8	–	20	2	5	–	–	–	15.88
" 17, . .	29.751	63.	43.	.76	68.	447	115	49	81	55	4	8	10	–	15	3	3	–	–	1	16.35
" 24, . .	30.007	77.	53.	.89	76.	384	96	43	72	42	7	5	6	–	17	4	–	–	–	2	14 86
" 31, . .	29.978	61.	44.	.85	80.	438	128	64	79	37	6	11	7	–	25	4	6	–	–	–	16.50
June 7, . .	30.046	78.	55.	.03	67.	424	115	56	95	41	5	23	6	3	7	2	5	–	–	2	16.31
" 14, . .	30.085	69.	55.	.33	84.	372	106	38	61	37	3	7	8	–	11	1	4	–	–	–	14 40
" 21, . .	29.897	83.	53.	.92	72.	402	1[illegible]8	58	83	36	6	14	10	–	14	2	3	–	–	1	15.00
" 28, . .	30.097	77.	59.	2 73	75.	421	128	63	69	27	5	25	5	–	14	1	4	–	–	3	15.41
July 5, . .	29.936	83.	63.	.84	76.	410	191	73	60	22	5	37	5	1	10	–	4	–	–	–	15.35
" 12, . .	29.798	80.2	61.	.77	76.7	471	203	122	71	26	4	81	3	–	12	4	12	–	–	–	17.68
" 19, . .	29.722	75.6	58.6	.70	72.6	494	224	170	55	18	8	109	6	1	12	3	9	2	–	–	18 58
" 26, . .	29.824	78.4	60.	.07	67.1	602	309	2[illegible]2	68	18	2	172	11	–	12	1	16	–	–	2	21.34

August 2, . .	29 921	73.	59.	1.89	82.7	562	285	215	67	14	12	167	8	1	8	1	12	1	–	–	21.50
" 9, . .	30.041	65.	64.	3.42	85.	541	265	203	73	24	9	152	5	1	13	1	15	–	–	–	20.44
" 16, . .	30.126	72.3	59.	.35	84.9	627	250	195	62	24	24	131	5	1	10	1	14	–	–	1	22.24
" 23, . .	30.013	80.	60.	–	87.	509	240	200	66	15	10	150	5	1	10	–	16	–	–	1	20.93
" 30, . .	29.789	74.	58.	.51	81.9	543	256	194	50	16	13	138	12	1	11	–	9	1	–	1	19.75
September 6, . .	30.013	84.	62.	.37	71.3	579	288	213	79	30	10	165	5	–	13	–	13	–	–	–	22.10
" 13, . .	30.040	83.5	62.2	.14	74.4	601	276	[illegible]39	83	25	22	155	10	–	18	2	3	–	–	1	22.09
" 20, . .	30.066	69.9	51.5	.04	67.8	534	226	145	83	16	16	91	6	–	16	2	9	–	–	1	20.64
" 27, . .	30.167	71.	51.6	.03	72.8	522	243	165	57	34	22	94	9	–	21	5	7	1	–	2	23.01
October 4, . .	30.076	82.7	56.7	.43	68.9	505	231	138	66	33	21	70	10	–	20	1	8	1	–	–	18.58
" 11, . .	29.979	66.6	45.7	.10	64.4	457	172	122	72	36	21	62	7	1	19	–	6	–	–	1	17.84
" 18, . .	30 005	60.3	43.2	.23	64.1	463	156	117	73	29	29	34	4	1	35	–	5	–	–	1	17.62
" 25, . .	30.135	60.7	48 3	.63	62.3	453	164	113	63	40	23	30	9	1	40	1	5	–	–	1	17.70
November 1, . .	30.196	[illegible]2.4	38.2	2.06	79.7	398	132	101	70	40	14	32	10	3	27	1	5	–	–	3	17.72
" 8, . .	30.050	50 5	33.9	.37	64.1	473	153	91	74	56	14	16	10	1	41	–	1	–	–	2	22.66
" 15, . .	30.216	54.5	39.	–	63.3	478	142	78	75	66	22	–	14	4	23	–	4	–	–	1	18.61
" 22, . .	30.159	46.2	[illegible]0.2	.35	80.1	414	107	82	63	54	14	8	5	3	38	1	–	1	–	5	15.60
" 29, . .	29.813	50 3	30.5	2.13	94.8	464	141	68	72	92	12	9	6	2	28	2	3	–	–	1	18.92
December 6, . .	30.071	45.3	31.	.27	64.2	485	139	87	80	92	19	7	7	3	38	1	5	1	–	2	19.29
" 13, . .	29 935	42.6	34.6	1.15	68.	485	158	79	65	92	14	2	23	–	38	–	2	–	–	–	18.15
" 20, . .	30.105	32.2	17.3	1.02	65.1	449	159	80	60	66	5	5	17	7	39	–	4	1	–	–	17.43
" 27, . .	30.374	36.2	15.5	2.02	78.3	357	110	25	62	74	9	5	5	2	20	1	2	1	–	4	17.43
Total, ...	–	–	–	47.82	–	24,246	8,462	5,083	3,725	2,563	542	2,167	431	46	1,098	103	261	15	2	89	18.13
Weekly average, .	–	–	–	–	–	466	162	97	72	49	10.2	42	8	1	21	2	5	.3	.04	2	–
Ratio per 1,000 deaths,	–	–	–	–	–	–	–	209.6	154.04	105.7	22.3	89.3	17.7	1.89	45.2	4.25	10.8	.618	.082	3.67	–
Ratio per 1,000 population, . . .	–	–	–	–	–	–	–	3.80	2.78	1.91	.405	1.62	.32	.034	.828	.075	.198	.011	.0015	.066	–

Total Deaths.

The whole number of deaths reported for the year 1884, from cities and towns included in the report, was 24,246, and the average number per week 466.

The greatest number of deaths reported was 627, in the week ending August 16. Least number 357, in the week ending December 27.

The weekly average number of deaths reported for each month was as follows : —

January,	449	July,	494
February,	447	August,	556
March,	487	September,	559
April,	418	October,	469
May,	411	November,	445
June,	405	December,	444

The months in which the greatest number of deaths was reported were August and September, and those in which the least number was reported were May and June.

The estimates of population of cities and towns are carefully made for the intervening years between the years of the National and the State Census, 1880–1885.

Of the 24,246 reported deaths, the percentages of mortality in the different quarters of the year were as follows : —

	First Quarter. Per Cent.	Second Quarter. Per Cent.	Third Quarter. Per Cent.	Fourth Quarter. Per Cent.
Total deaths,	24.84	22.05	28.85	24.25
Deaths under 5,	20 61	17.70	38.47	23.21

The death-rate of reporting cities and towns was 19.16 on an estimated population of 1,265,000.

Deaths under Five Years.

The whole number reported was 8,462, the weekly average for the year being 162.

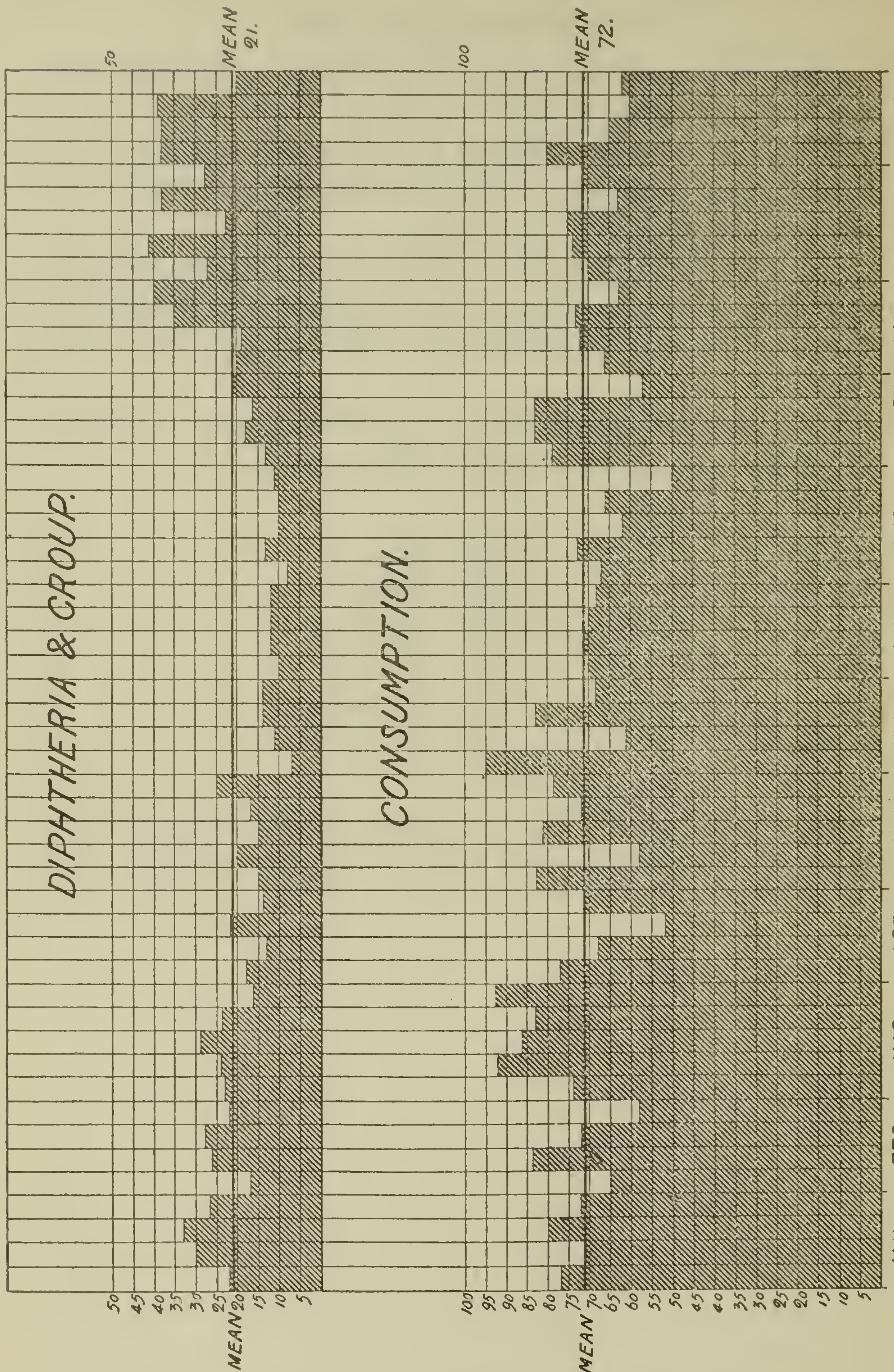
The least number reported in any week was 96, in the week ending May 24; and the greatest number 309, in the week ending July 26.

The ratio of deaths under 5 to the total number of deaths was 34.9, or one in 2.86; a little less than that of 1883, and also less than the average for the whole State for ten years, 1871–80.

The average weekly number of reported deaths of children under 5 years, for each month, was as follows: —

January,	122	July,	232
February,	137	August,	259
March,	141	September,	258
April,	118	October,	181
May,	111	November,	135
June,	117	December,	141

Months having the least number of deaths, May and June.
Months having the greatest number, August and September.


DIPHTHERIA & CROUP.
CONSUMPTION.
MEAN 21.
MEAN 72.
JAN.
FEB.
MAR.
APR.
MAY
JUN.
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.

Consumption.

The reported number of deaths from consumption was 3,725. The reported weekly average for the year was 72.

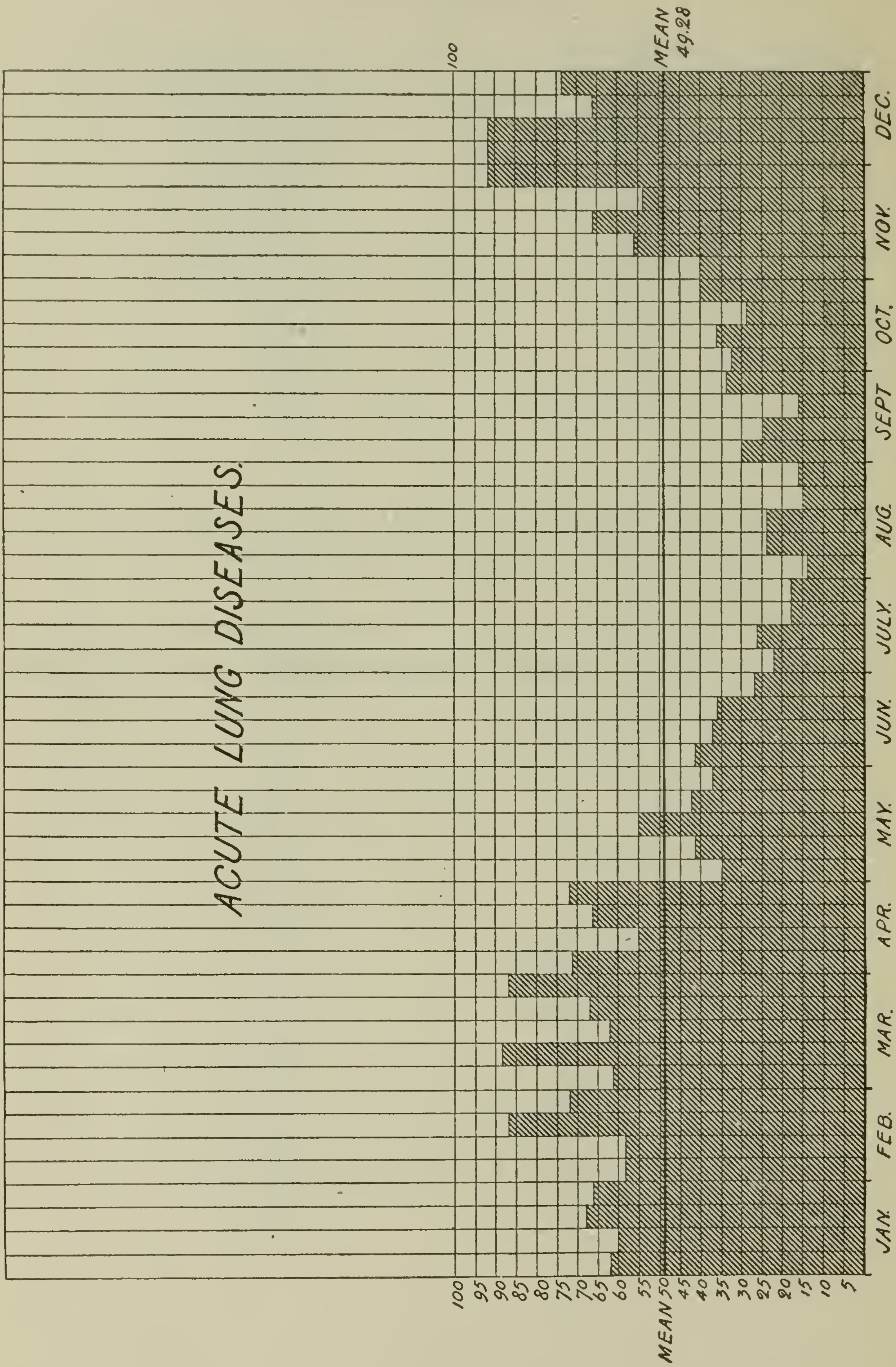
The average weekly number of deaths reported for each month was as follows:—

January,	75	July,	63
February,	69	August,	64
March,	86	September,	75
April,	67	October,	69
May,	75	November,	71
June,	77	December,	67

The months having the least number of deaths were July and August. Months having the greatest number were March and June.

The uniformity of the rate of mortality from this disease is quite marked. The ratio per thousand of reported deaths from all causes was 154.04, the ratio for the previous year being 155.9.

The diminution in mortality from consumption is still more marked than that of the previous year; the death rate per 1,000 of the population as reported being but 2.78. For the preceding year, as reported, it was 3.08. The marked change in the death rate from this, the most destructive of all diseases in New England is especially noticeable in the reports of the past year. Greater accuracy of registration may account for this in a measure, but the change is so marked, that other and more definite causes must be sought in the character of the population, improved sanitary conditions, and causes deeply affecting the habits and life of the population of the State.


ACUTE LUNG DISEASES.
MEAN 49.28
100
DEC.
NOV.
OCT.
SEPT
AUG.
JULY.
JUN.
MAY.
APR.
MAR.
FEB.
JAN.
100 95 90 85 80 75 70 65 60 55 MEAN 50 45 40 35 30 25 20 15 10 5

Acute Lung Diseases: Pneumonia, Bronchitis, Asthma, Pleurisy.

The number of deaths reported from acute lung diseases was 2,563. The weekly average 49.

The average weekly number reported in each month was as follows : —

January,	64	July,	21
February,	69	August,	19
March,	73	September,	26
April,	66	October,	34
May,	42	November,	61
June,	35	December,	81

The months having the least number of reported deaths were July and August. Those having the greatest number were March and December.

The ratio per 1,000 deaths from acute lung diseases was 105.7. For the previous year it was 103.4.

The ratio per 1,000 of the estimated reporting population was 1.91. For the previous year the ratio was 2.15.

*Typhoid Fever.**

The number of reported deaths from typhoid fever was 542, and the weekly average 10.

The average number in each month was as follows : —

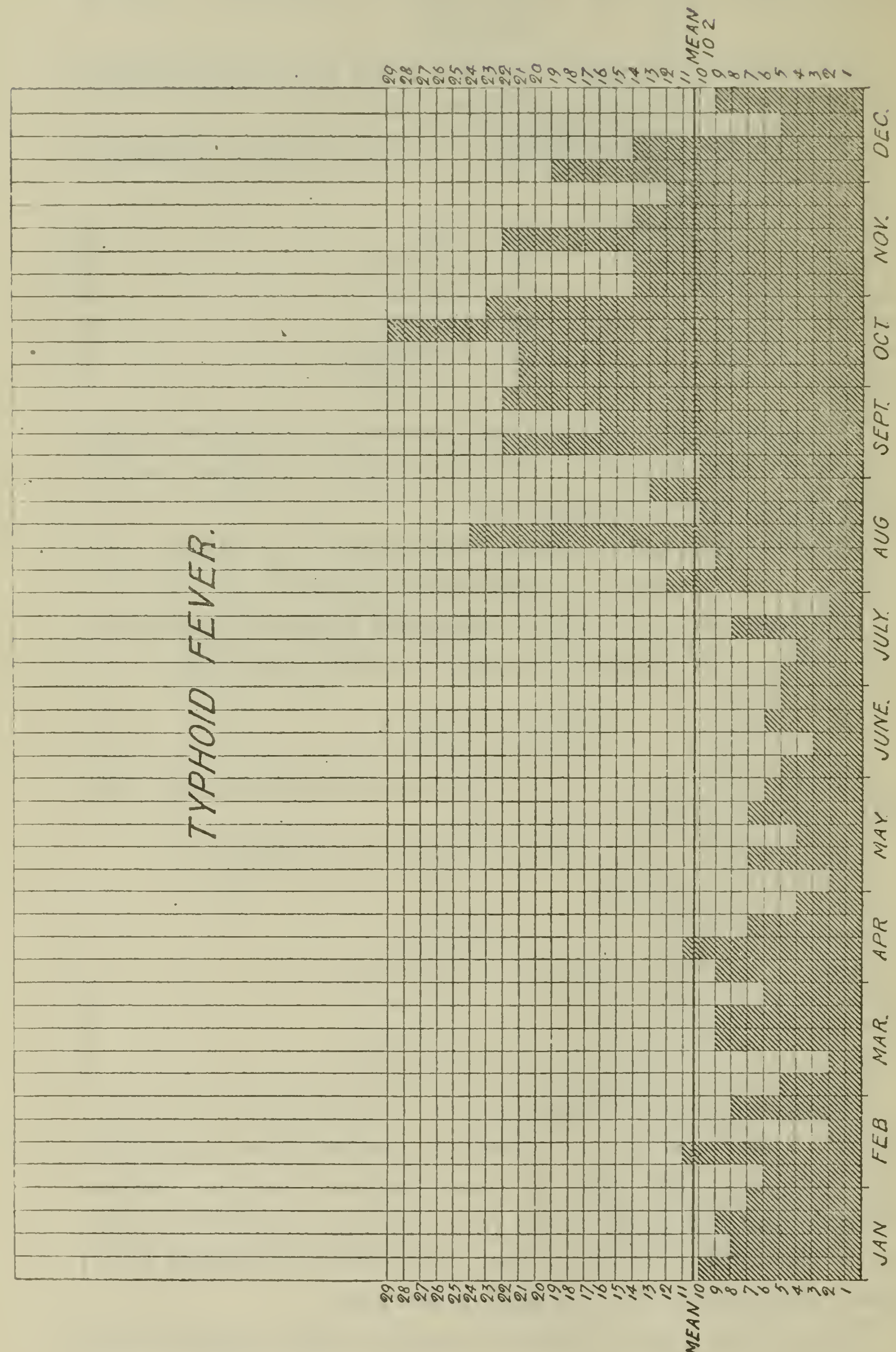
January,	8	July,	5
February,	8	August,	14
March,	6	September,	17
April,	8	October,	23
May,	5	November,	15
June,	5	December,	12

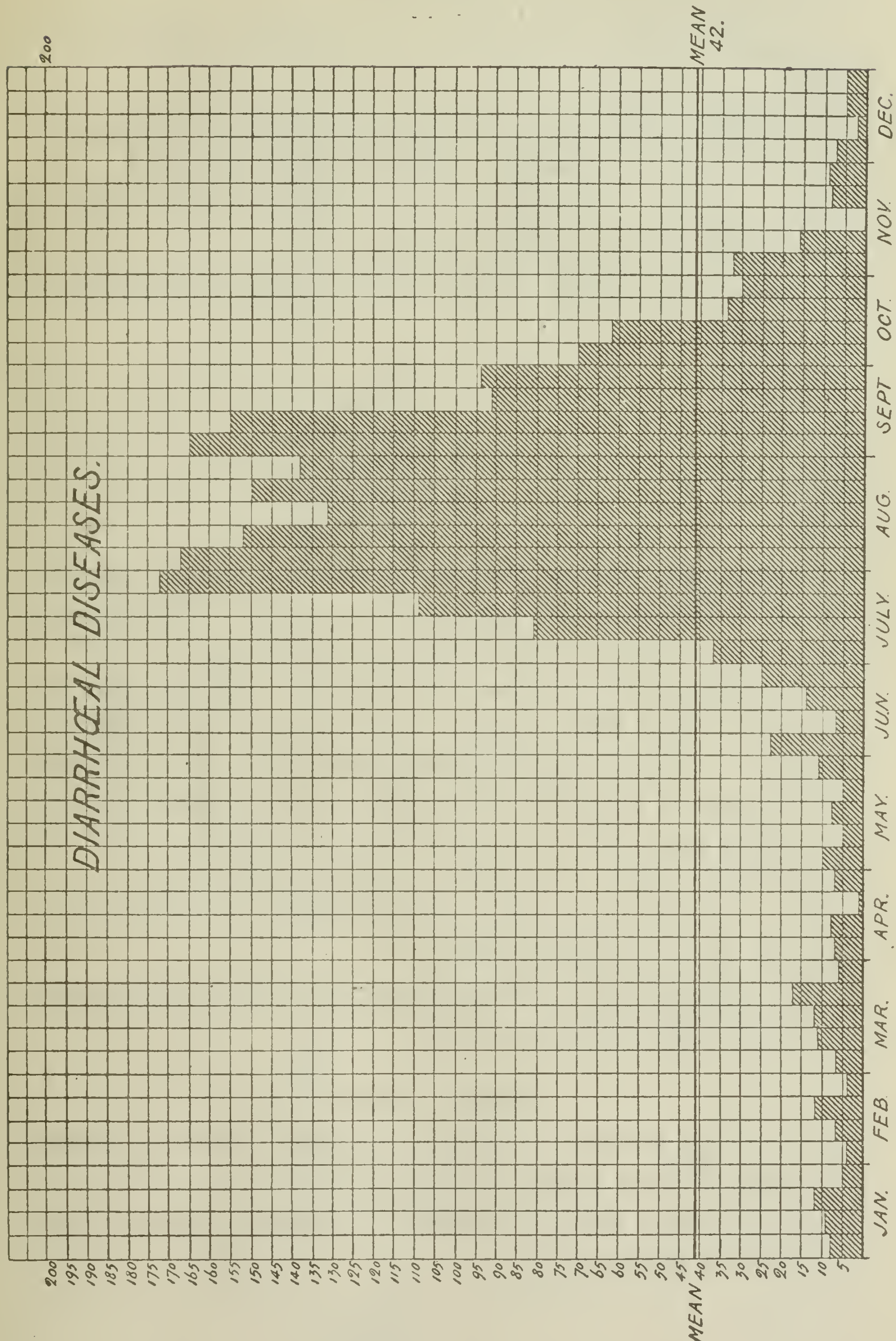
The months having least number of deaths were June and July. Those having the greatest number were September and October. The ratio of cases reported for the last six months, and especially of the three autumn months was similar to that of the previous year, more than two-thirds of all cases occurring in the last half of the year.

The ratio per 1,000 deaths from all causes reported was 22.5 which was slightly in excess of that reported for 1883 (20.9).

The average annual mortality from typhoid fever by the

* See chart on page 228.


TYPHOID FEVER.
MEAN 10 2
JAN
FEB
MAR.
APR
MAY
JUNE.
JULY.
AUG
SEPT.
OCT.
NOV.
DEC.


DIARRHŒAL DISEASES.
MEAN 42.
JAN.
FEB
MAR.
APR.
MAY.
JUN.
JULY.
AUG.
SEPT
OCT.
NOV.
DEC.
200 195 190 185 180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5
MEAN

decade 1861–70 was 46.9 per 1,000 deaths from all causes; for the decade 1871–80 it was 31.7.

The mortality per 1,000 of the living population as reported was .405.

*Diarrhœal Diseases, including Diarrhœa, Dysentery, Cholera Infantum, Cholera and Enteritis.**

The number of deaths reported from diarrhœal diseases was 2,167, and the weekly average 41.

The average weekly number in each month was distributed as follows: —

January,	8	July,	100
February,	7	August,	148
March,	11	September,	126
April,	6	October,	49
May,	8	November,	13
June,	17	December,	5

The months having the least number of deaths from this group of diseases were April and December. Those having the greatest number were August and September.

The mortality in the last six months of the year was 88.7 per cent. of the whole number for the year, and for the three months of July, August and September it was 75.7 per cent.

The ratio of reported deaths to the whole number reported was 89.4 per 1,000. In 1881 it was 87.8 per 1,000. In 1882 it was 100.8. In 1883 (reported deaths) 91.8.

The reported ratio for the United States was 8.66 (U. S. census, 1880, mortality tables).

The mortality for 1,000 of the living population as reported was 1.62. For 1883 it was 1.9.

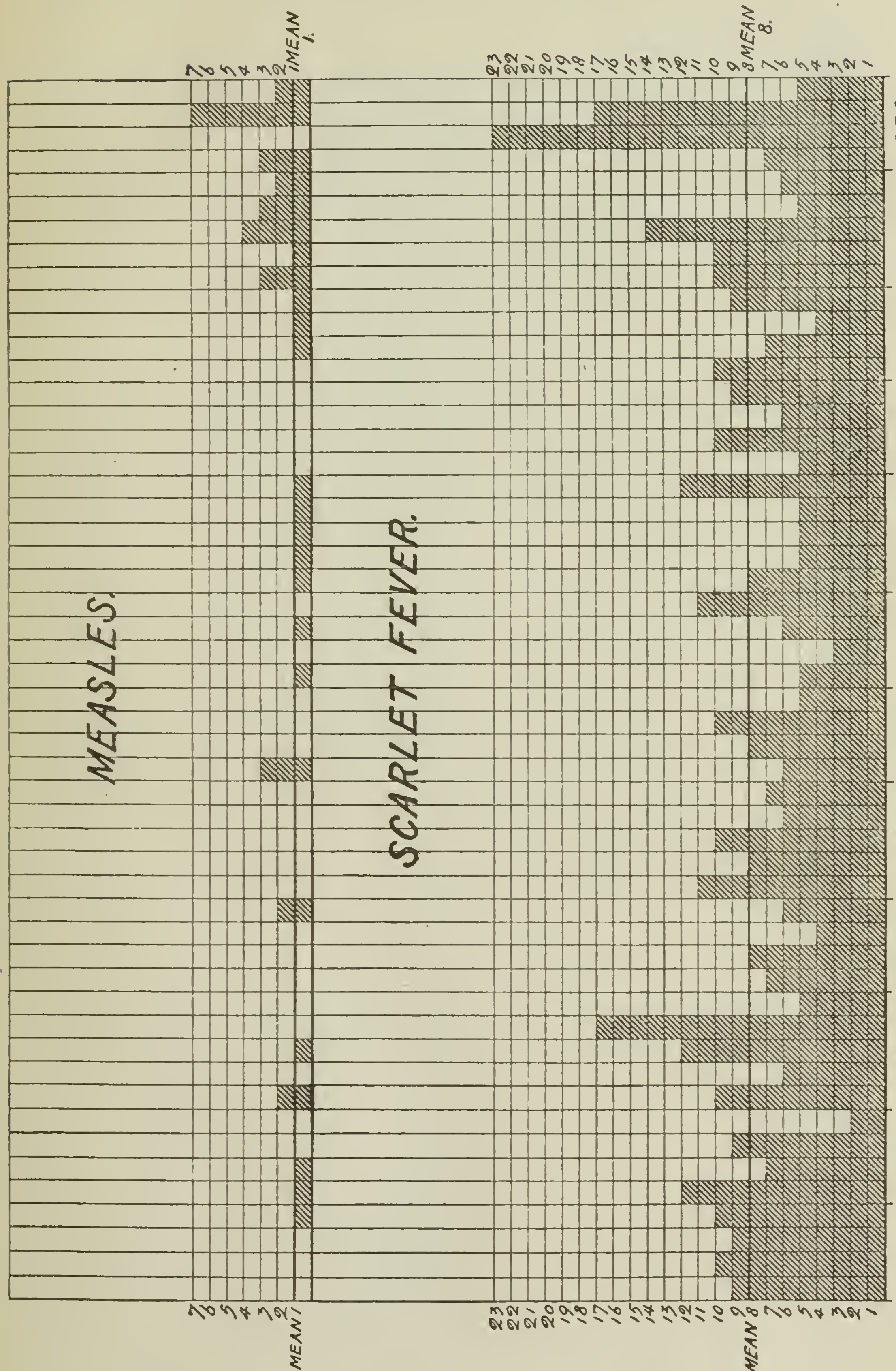
Scarlet Fever.

The total number of deaths reported from this disease was 431, and the weekly average, 8.

The average weekly mortality of reported cases in each month was as follows: —

January,	9	July,	6
February,	7	August,	7
March,	10	September,	7
April,	6	October,	7
May,	8	November,	9
June,	7	December,	13

* See chart on page 229.


MEASLES.
SCARLET FEVER.
MEAN 1.
MEAN 8.
JAN.
FEB.
MAR.
APR.
MAY
JUN.
JULY.
AUG
SEPT.
OCT.
NOV
DEC.

The two months having the least number of deaths were April and July, and those having the greatest number were March and December.

The ratio of deaths from scarlet fever to deaths from all causes was 17.7 per 1,000, being slightly in excess of that of the previous year. For 1883 it was 16.2. It was much less than the average for the twenty years 1861–1880 inclusive, the average being 36.6.

The ratio of deaths per 1,000 of the living population was .32.

*Measles.**

The whole number of deaths reported from measles for the year was 46; the weekly average, less than 1.

There were no deaths in April and September. The months having the greatest number of deaths were November and December.

The fatality from this disease was very much less than that of the previous year, which was increased by a severe and widespread epidemic in eastern Massachusetts.

The ratio of deaths reported to deaths from all causes was 1.8 per 1,000, much less than the average for twenty years, — 1861–80, — the average of those years being 7.38. For the previous year it was 10.7.

The ratio of deaths per 1,000 of the living population was .034.

Diphtheria and Croup.†

The total number of deaths reported from these diseases for 1884 was 1,098; the weekly average, 21.

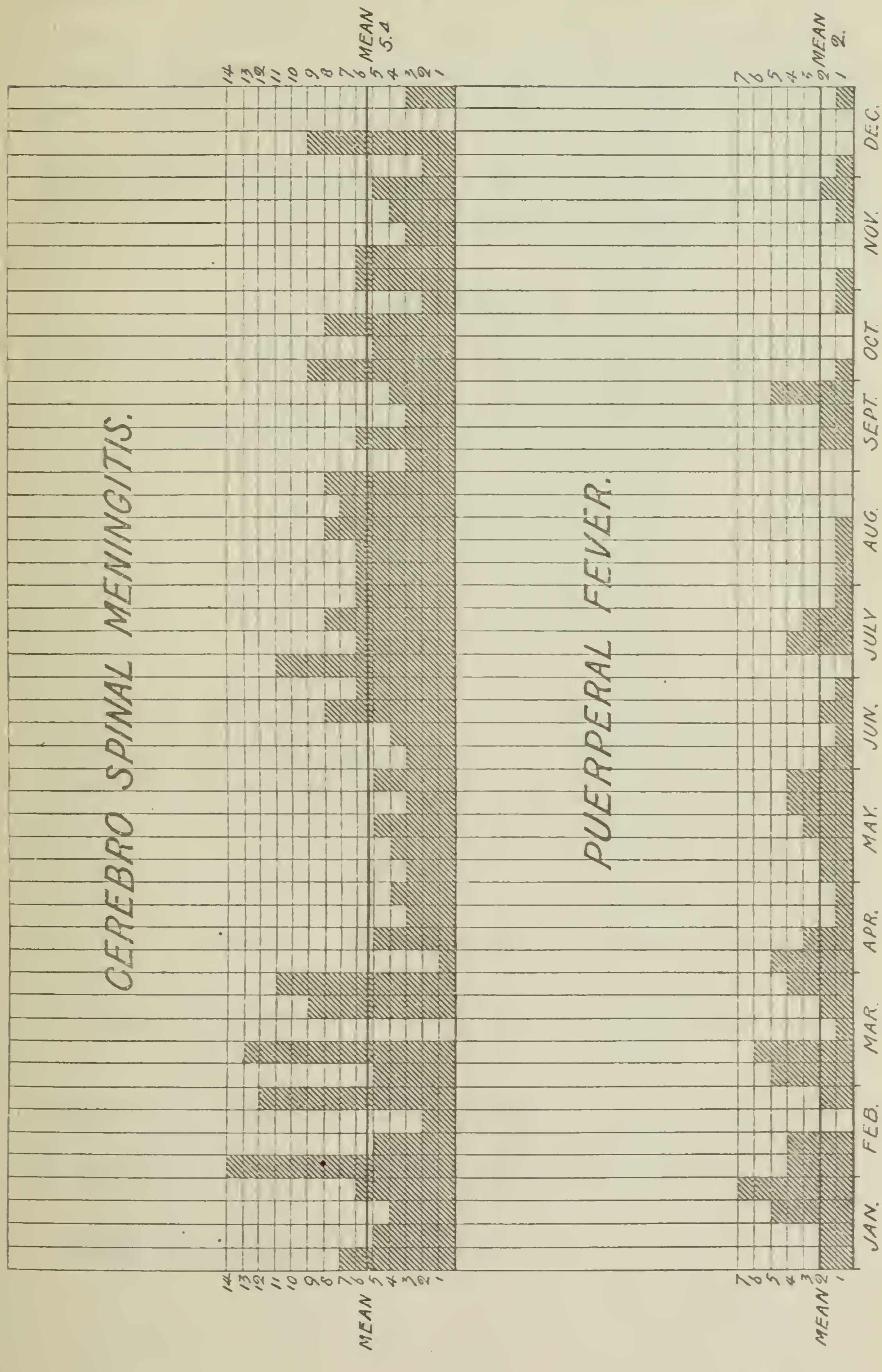
The average weekly mortality was distributed as follows for all reported cases: —

January,	28	July,	11
February,	23	August,	10
March,	23	September,	17
April,	17	October,	28
May,	18	November,	31
June,	11	December,	34

The two months having the least number of deaths were June and July, and the two months having the greatest number were October and December.

* See chart on page 231.

† See chart on page 224.


CEREBRO SPINAL MENINGITIS.
PUERPERAL FEVER.
MEAN 5.4
MEAN 2.
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.

The ratio of reported deaths from these diseases to deaths from all causes was 40.5 per 1,000, considerably less than the average per year for ten years (1871–80), as reported by Dr. Folsom in the Thirty-ninth Registration Report. It was also less than that of the previous year which was 49.1.

The death rate per 1,000 of the living population, as calculated from reported cases, was .82.

*Puerperal Fever.**

The total number of deaths reported from puerperal fever was 103, an average weekly mortality of 2.

The weekly average per month was as follows : —

January,	4.	July,	2.
February,	2.5	August,	.6
March,	3.6	September,	2.25
April,	2.5	October,	.5
May,	3.	November,	.8
June,	1.5	December,	.5

The months having the least mortality per week were October and December. Those having the greatest mortality were January and March. The mortality was not uniformly distributed throughout the year, but was greater in the first six months, 73 per cent. of the cases having been reported in the first half of the year.

The ratio per 1,000 deaths from all causes was 4.2. For 1883 it was 5.6.

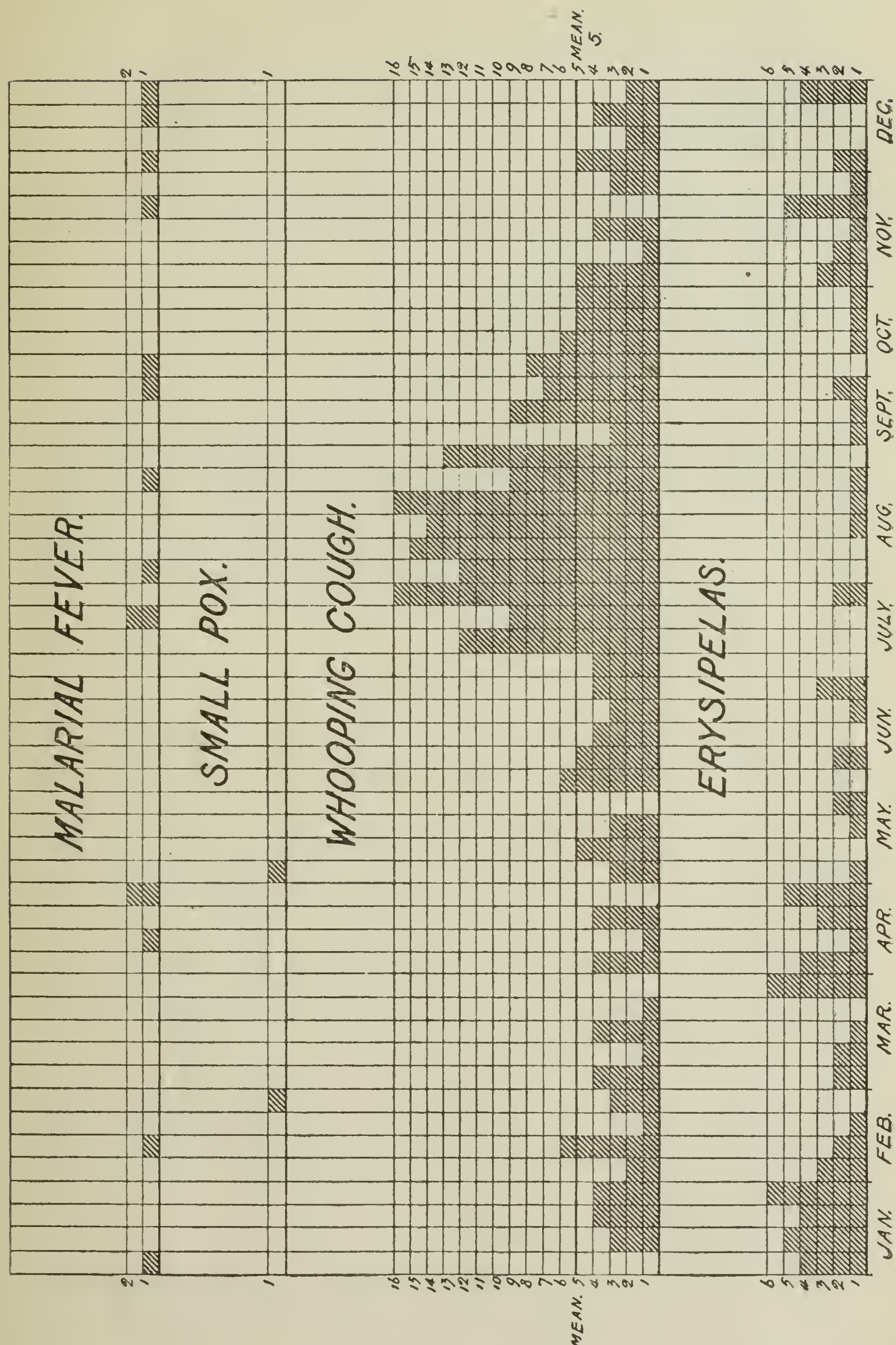
The mortality per 1,000 of the living population was .077.

Whooping-cough, Erysipelas, Malarial Fever, Small-pox.

The reported deaths from these diseases have been as follows : —

	Total Deaths reported.	Weekly Average.
Whooping-cough,	264.	5.
Erysipelas,	89.	1.7
Malarial fever,	15.	.3
Small-pox,	2.	.04

* See chart on page 233.


MALARIAL FEVER.
SMALL POX.
WHOOPING COUGH.
ERYSIPELAS.
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JULY.
AUG.
SEPT.
OCT.
NOV.
DEC.
MEAN.

The mortality per 1,000 deaths from all causes was as follows: —

Whooping-cough,	10.9
Erysipelas,	3.6
Malarial fever,	.6
Small-pox,	.8

The mortality per 1,000 of the living population as reported was as follows: —

Whooping-cough,	.19
Erysipelas,	.066
Malarial fever,	.011
Small-pox,	.0014

The rate of mortality from whooping-cough is noticeable when compared with that of the previous year. It was not excessive when compared with the rate for a series of years, since the rate for the year 1883 was much less than that of any year since 1857.

*Malarial Fever.**

The total number of deaths reported from malarial fever for 1884 was fifteen. These cases were distributed as follows: —

Eastern counties. Boston, Groton, Quincy, Chelsea, Fall River, Lynn, one each, six in all — or a mortality of .0042 per 1,000 of the living population.

Five western counties. Springfield, 5; Chicopee, 2; Westfield and Spencer, 1 each, 9 in all — or a mortality of .017 per 1,000 of the living population.

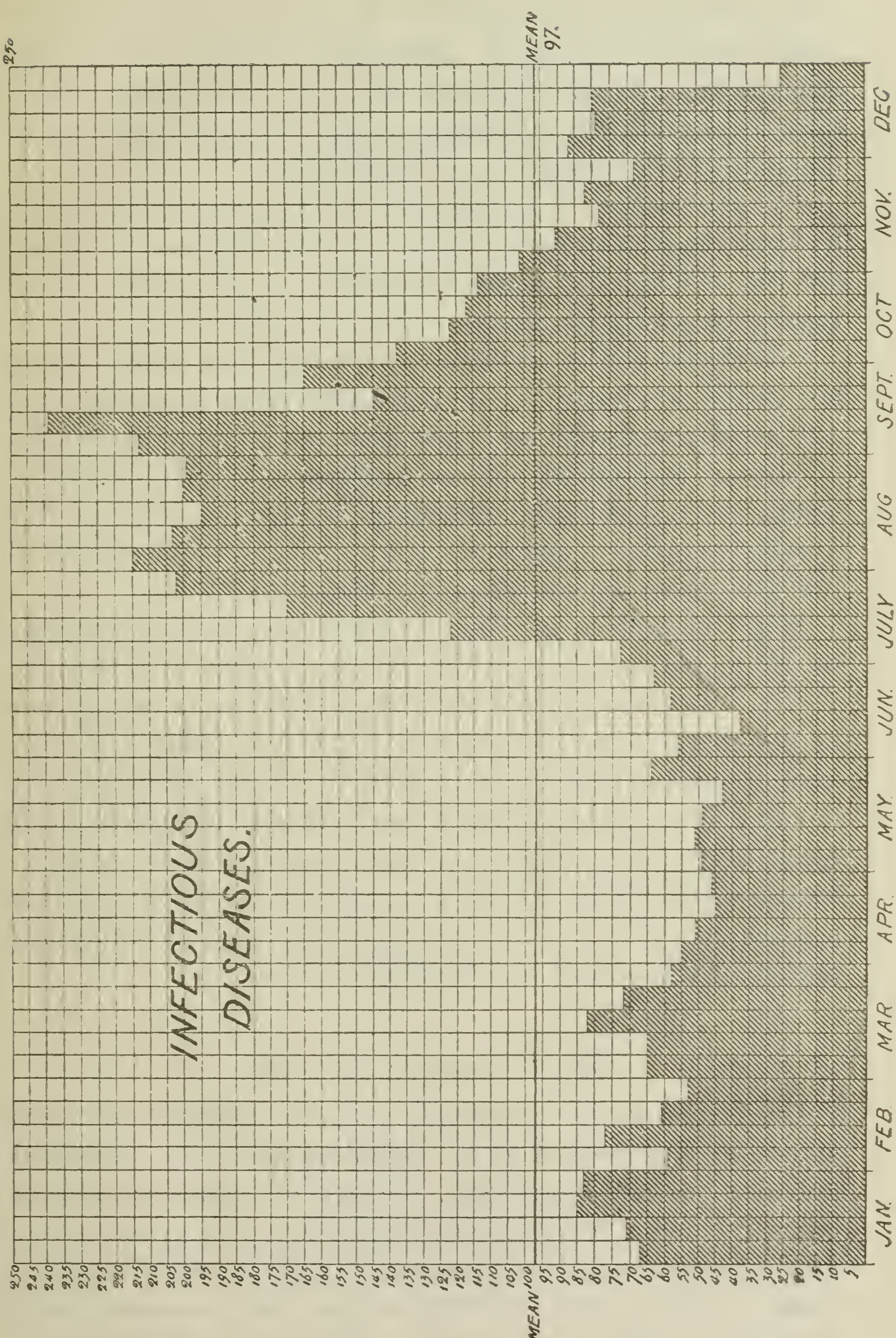
At the time of writing this report (Aug. 1885) an outbreak of malarial fever is prevailing at South Framingham, a report of which in full will be giving in the supplement of next year.

Small-Pox.†

The immunity of Massachusetts from small-pox in 1884 was still more marked than that of 1883. Two deaths only occurred from this disease during the year. So far as can be ascertained from the records of this disease, no year has shown so favorable a report for a century or more. In this

* See chart on page 235.

† See chart on page 235.


INFECTIOUS
DISEASES.
MEAN
97.
MEAN 100
250
JAN.
FEB.
MAR
APR.
MAY
JUN.
JULY
AUG
SEPT.
OCT
NOV.
DEC

connection the following statement, relative to the protection afforded by vaccination in London, is valuable. Dr. Buchanan says, "In 1881, among the 55,000 children who had not been vaccinated, there were 782 deaths from small-pox; among the 861,000 children who had been vaccinated, there were 125 deaths from small-pox.

"If the London children under 10 who were unvaccinated had had the protection which the current vaccination gives, not 782 of them, but at the outside *nine*, would have died of small-pox during the year.

"If the 861,000 vaccinated children had died at the rate of the 55,000 unvaccinated, we should not now be considering 125 small-pox deaths, and how they can be reduced, but we should be confronted with an additional 12,000 and more deaths from small-pox, occurring during the year in the London population under 10 years of age. This saving of life was essentially the effect of vaccination." *

With these facts in view, and also the terrible scourge which is prevailing at Montreal at present (September, 1885), it is desirable that the statutes relative to vaccination in this State should be carefully and thoroughly enforced, and especially that the law relative to the attendance of unvaccinated scholars in the schools should be carried out in every town in the State. A recent inquiry, made throughout the State by the Health Department, reveals a culpable neglect in many towns with reference to this important matter, which should be remedied at once.

Death Rates of Cities.

In addition to the mortality rates from infectious diseases which were presented in the supplement of last year, and are also presented for 1884, the general mortality rates of cities reporting to the Board weekly are also given, so far as the reports have been received. In the charts illustrating these mortality rates, it will be noticed that occasional gaps or breaks occur in the record. These are occasioned by the failure of such cities to report the mortality of the weeks indicated.

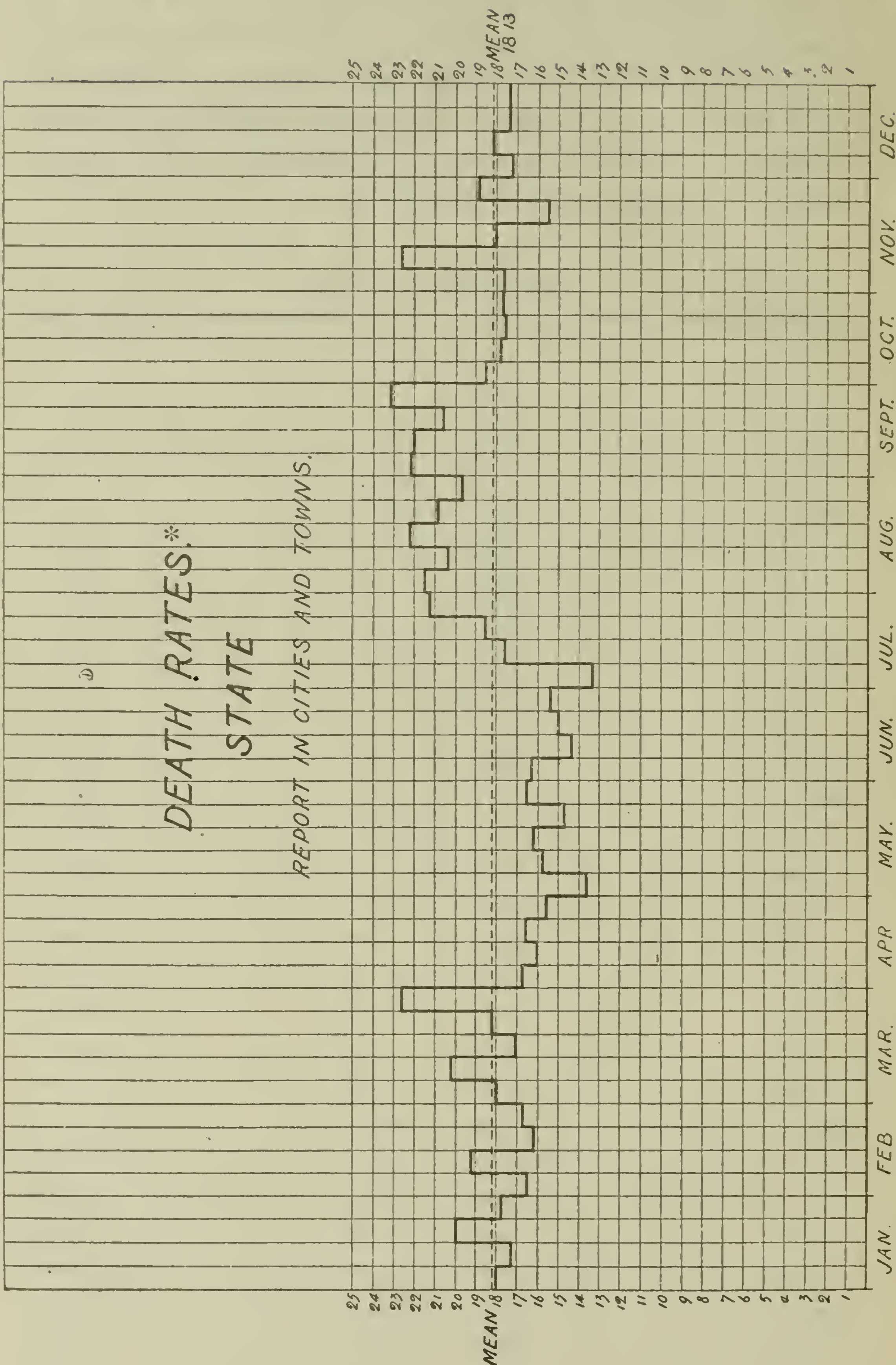
* Eleventh Report of Local Government Board of England — Supplement, 1882, p. viii.

In making up the mortality rates, the population of cities has been estimated by a careful method, which is found to be as nearly accurate as possible. The prevailing tendency is to overestimate populations, and hence to reduce the actual death rate. It may be necessary, therefore, in some instances, to increase the rate, as calculated, to the amount of one or one and one-half per 1,000.

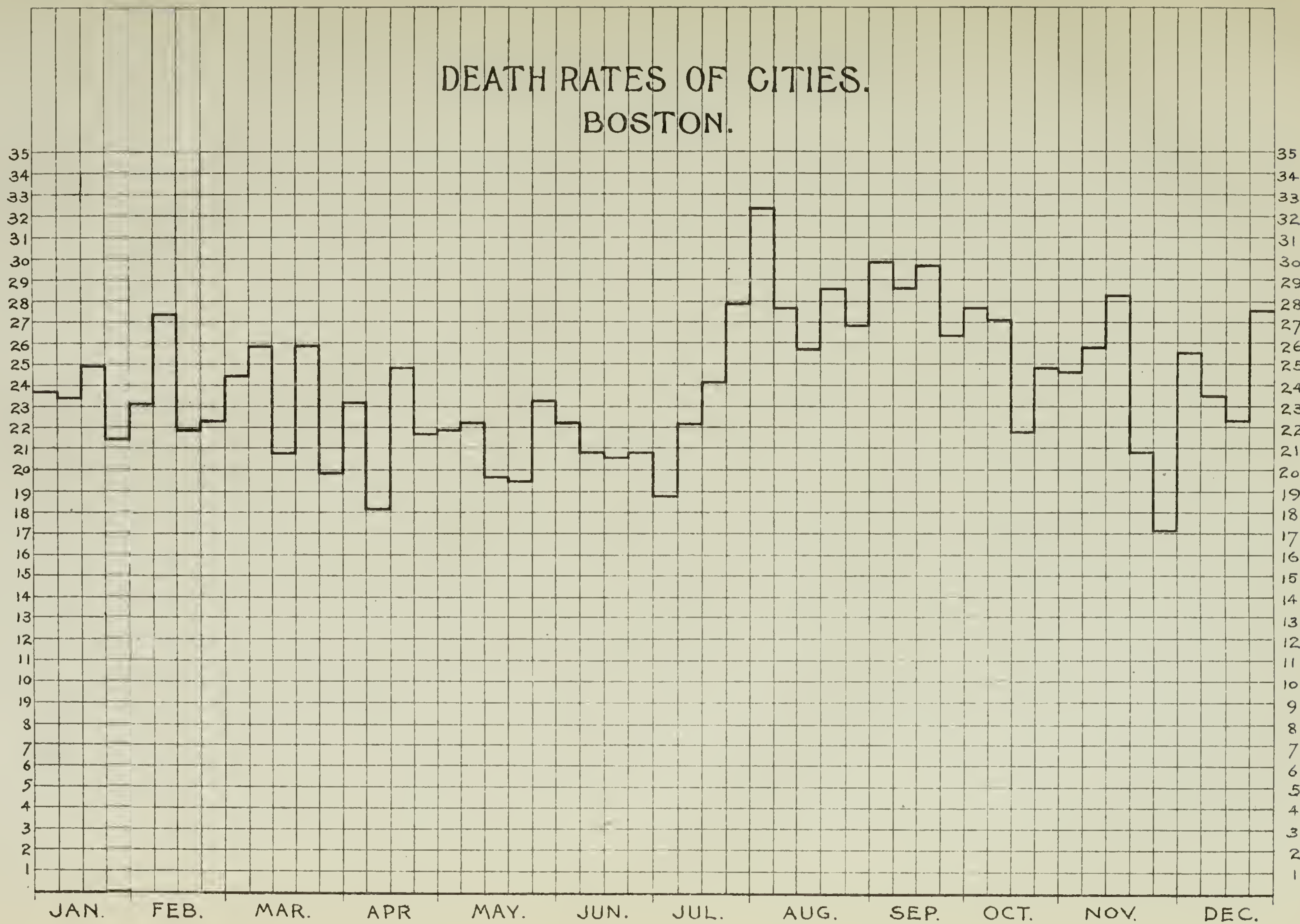
Death-rates of Cities.

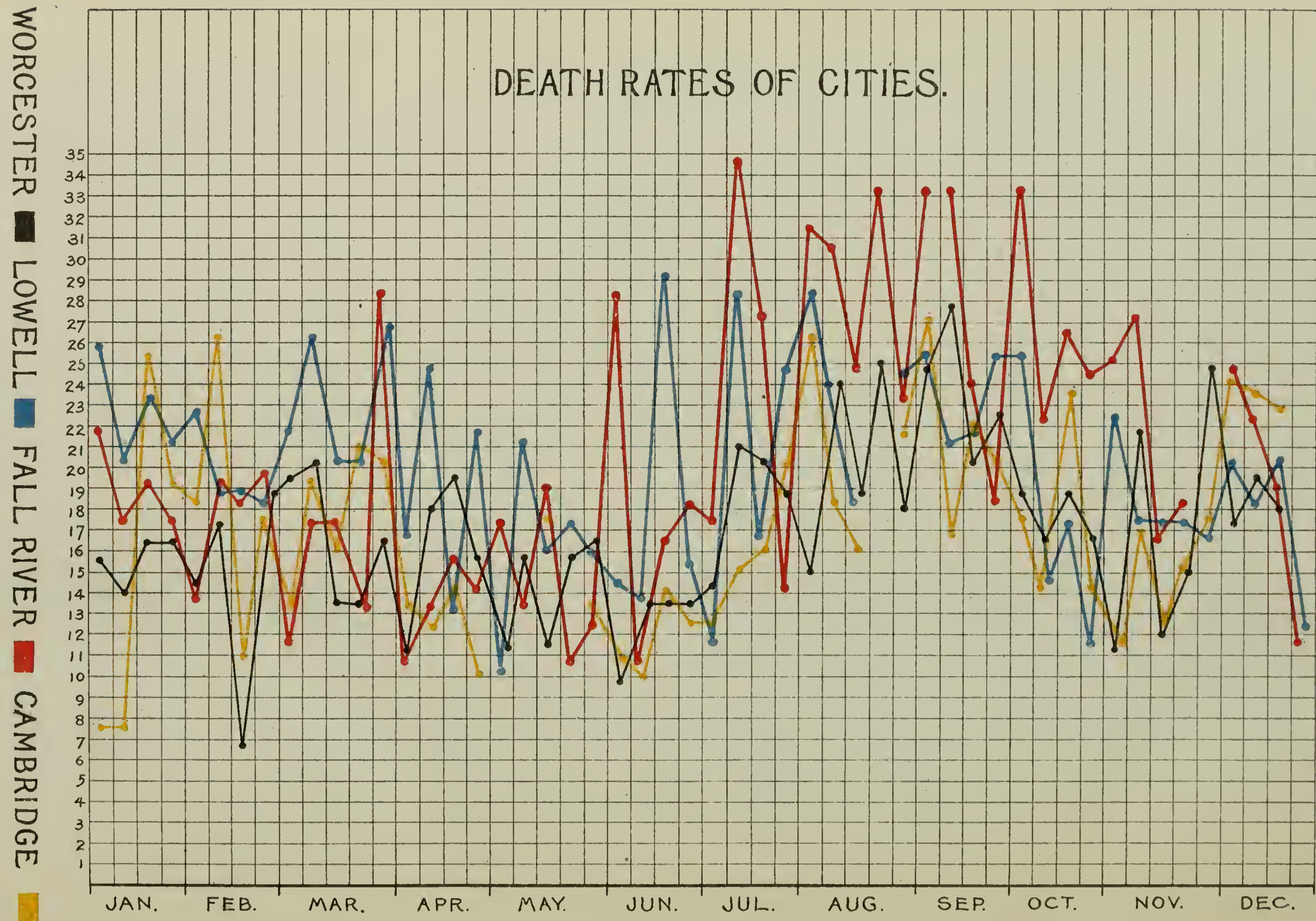
	Boston.		Boston.
Jan. 5,	23.73	July 5,	18.76
12,	23.48	12,	22.07
19,	24.94	19,	24.05
26,	21.46	26,	27.94
Feb. 2,	23.06	Aug. 2,	32.36
9,	27.36	9,	27.61
16,	21.91	16,	25.70
23,	22.30	23,	28.60
March 1,	24.44	30,	26.76
8,	25.85	Sept. 6,	29.91
15,	20.74	13,	28.60
22,	25.88	20,	29.65
29,	19.90	27,	26.37
April 5,	23.09	Oct. 4,	27.68
12,	18.11	11,	27.03
19,	24.78	18,	21.78
26,	21.65	25,	24.85
May 3,	21.91	Nov. 1,	24.67
10,	22 30	8,	26.72
17,	19.68	15,	28.21
24,	19.54	22,	20.86
31,	23.22	29,	17.06
June 7,	22.17	Dec. 6,	25.58
14,	20.86	13,	23.47
21,	20.59	20,	22.30
28,	20.80	27,	27.55

Estimated population of Boston for 1884, ... 384,893
Death-rate, ... 25.07



Death-rates — State. See pages 220 and 221.


DEATH RATES OF CITIES.
BOSTON.
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
JAN.
FEB.
MAR.
APR
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.


DEATH RATES OF CITIES.
WORCESTER
LOWELL
FALL RIVER
CAMBRIDGE
35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
JAN. FEB. MAR. APR. MAY. JUN. JUL. AUG. SEP. OCT. NOV. DEC.

Death-rates of Cities.

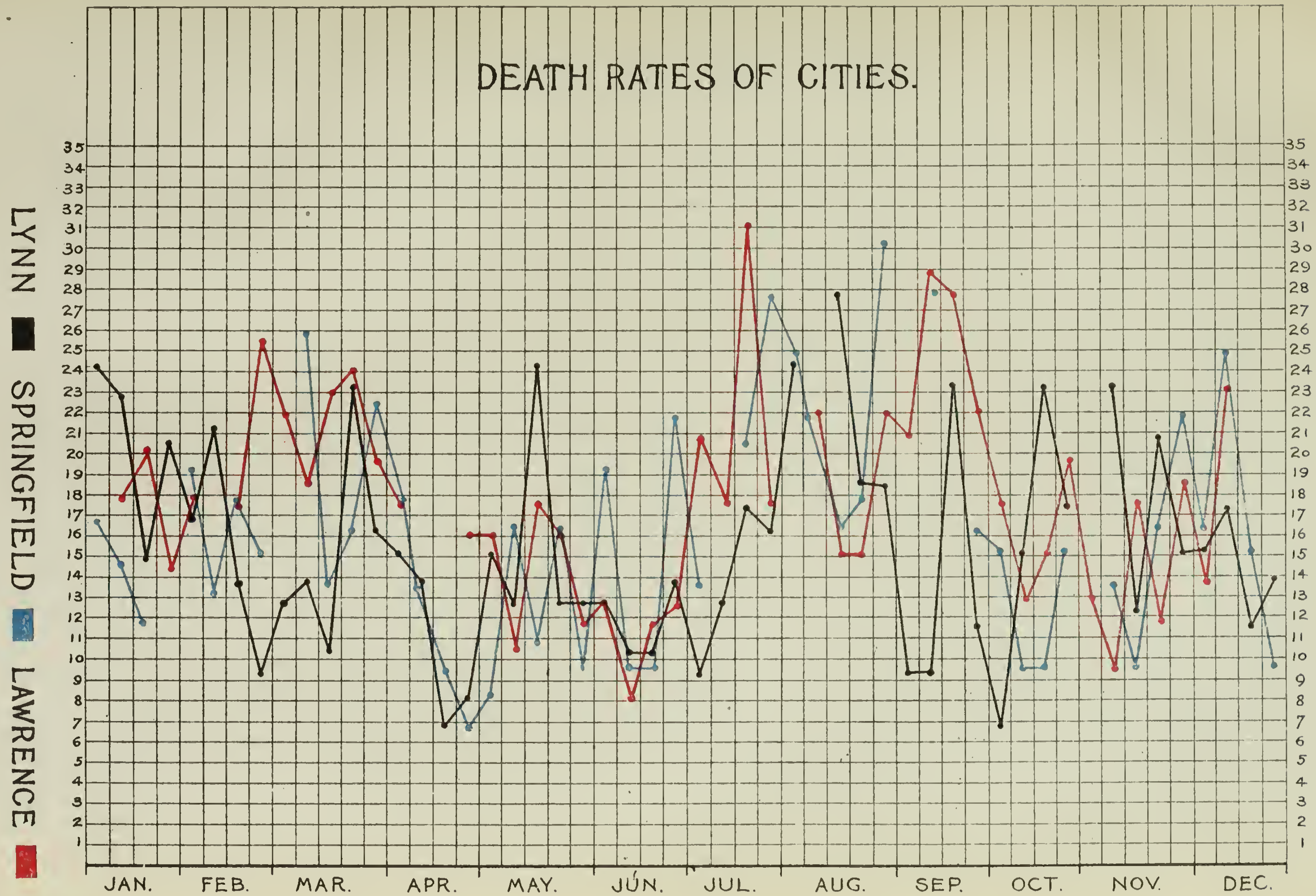
	Lowell.	Worcester.	Fall River.	Cambridge.		Lowell.	Worcester.	Fall River.	Cambridge.
Jan. 5, . .	25.77	15.56	21.74	7.98	July 5, . .	11.64	14.25	17.41	12.78
12, . .	20.31	14.00	17.42	7.98	12, . .	28.38	21.00	34.82	15.34
19, . .	23.40	16.34	19.16	25.69	19, . .	16.74	20.25	27.36	16.19
26, . .	21.09	16.34	17.42	19.50	26, . .	24.74	18.75	14 21	20.46
Feb. 2, . .	22.65	14.45	13.94	18.61	Aug. 2, . .	28.38	15.00	31.50	26.41
9, . .	18.74	17.12	19.16	26.58	9, . .	24.01	24.00	30.67	18.60
16, . .	18.92	6.72	18.24	11.08	16, . .	18.19	18.75	24.87	16.19
23, . .	18.19	18.75	19.89	17.89	23, . .	–	25.00	33.16	–
March 1, . .	21.83	19.50	11.61	13.63	30, . .	24.56	18.00	23.21	21.95
8, . .	26.20	20.25	17.41	19.60	Sept. 6, . .	25.47	24.75	33.16	27.26
15, . .	20.38	13.55	17.41	16.19	13, . .	21.10	27.75	33.16	17.04
22, . .	20.38	13 50	13.26	21.30	20, . .	21.83	20.25	24.02	22.15
29, . .	26 92	16.50	28.19	20.45	27, . .	25.46	22.50	18.24	20.45
April 5, . .	16.74	11.25	10.78	13.63	Oct. 4, .	25.47	18.75	33.16	17.89
12, . .	24.74	18.00	13.26	12 50	11, . .	14.55	16.50	22.18	14.48
19, . .	13.09	19.50	15.75	14.48	18, . .	17.46	18.75	26.52	23.85
26, . .	21.81	15.75	14.09	10.22	25, . .	11.64	16.50	24.57	14.48
May 3, . .	10.19	11.25	17.41	–	Nov. 1, . .	22.56	11.25	25.09	11.92
10, . .	21.11	15.75	13.26	–	8, . .	17.46	21.75	27.36	17.04
17, . .	16.01	11.45	19.08	17.89	15, . .	17.45	12.00	16.58	12.78
24, . .	17 46	15.75	10.78	–	22, . .	17.46	15.00	18.24	15.34
31, . .	16.01	16.50	12 44	13.63	29, .	16.74	24.85	–	17.89
June 7, . .	14.55	9.75	28.19	11.04	Dec. 6, . .	20.30	17.28	24.87	24.41
14, . .	13.83	13.50	10.78	10.22	13, . .	18.19	19.50	22.38	23.87
21, . .	29.11	13.50	16.50	14.48	20, . .	20.38	18.00	19 06	23.00
28, . .	15.29	13.50	18.24	12.78	27, . .	12.37	–	11.61	–

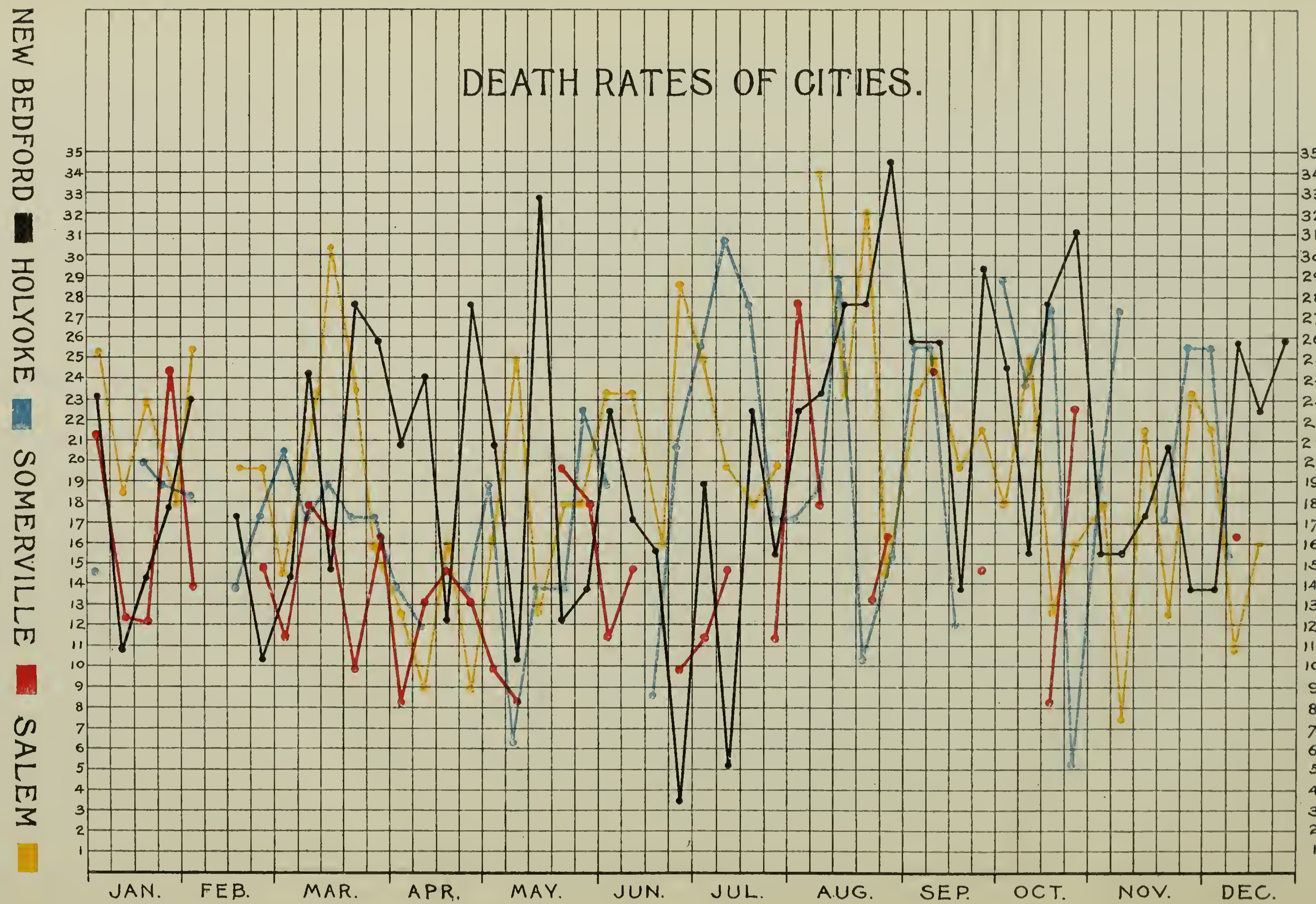
Estimated population of Lowell (1884), ... 63,135
Death-rate, ... 22.17
Estimated population of Worcester, ... 66,363
Death-rate, ... 19.74
Estimated population of Cambridge, ... 58,268
Death-rate, ... 18.79
Estimated population of Fall River, ... 55,283
Death-rate, ... 24.74

Death-rates of Cities.

	Lawrence.	Lynn.	Springfield.		Lawrence.	Lynn.	Springfield.
Jan. 5, . .	–	2.42	16.66	July 5, . .	20.48	9.26	13.65
12, . .	17.65	22.78	14 59	12, . .	17.13	12.74	–
19, . .	20.00	14.93	11.75	19, . .	30.84	17.37	20.48
26, . .	14.12	20.56	–	26, . .	17.13	16 21	27.67
Feb. 2, . .	17.64	16.93	19.09	Aug. 2, . .	–	24.32	24 87
9, . .	–	21.29	13 22	9, . .	21.69	–	21.84
16, . .	17.13	13.90	17.74	16, . .	14.85	27.79	16.38
23, . .	25.12	9.26	15.02	23, . .	14.85	18.69	17.75
March 1, . .	21.71	12.74	–	30, . .	21.70	18.53	30.03
8, . .	18.27	13.90	25.94	Sept. 6, . .	20.56	9.26	–
15, . .	22.84	10.42	13.65	13, . .	28.55	9.27	27.84
22, . .	23 93	23.16	16.38	20, . .	27.41	23 16	–
29, . .	19 41	16.21	22.44	27, . .	21.70	11.58	16.38
April 5, . .	17.13	15.05	17.75	Oct. 4, . .	17.04	6.94	15.02
12, . .	–	13 90	13.65	11, . .	12.56	15.05	9.58
19, . .	–	6.95	9.56	18, . .	14 85	23.16	9.56
26, . .	15.98	8.11	6.83	25, . .	19.41	17.37	15.06
May 3, . .	15.98	15.05	8.19	Nov. 1, . .	12.56	–	–
10, . .	10.26	12.74	16.38	8, . .	9.06	23.16	13.65
17, . .	17.13	24.32	10.92	15, . .	17.13	12.17	9.56
24, . .	15.98	12.74	16.38	22, . .	11 42	20.84	16 38
31, . .	11.42	12.74	9.56	29, . .	18.27	15.05	21.84
June 7, . .	12.56	12.74	19.11	Dec. 6, . .	13.17	15.05	16 38
14, . .	7.99	10.42	9.56	13, . .	22.84	17.37	24.94
21, . .	11.42	10.42	9.56	20, . .	–	11.58	15 02
28, . .	12.28	13.89	21.84	27, . .	–	13.90	9.66

Estimated population of Lawrence (1884), ... 38,880
Death-rate, ... 22.94
Estimated population of Lynn, ... 44,344
Death-rate, ... 15.65
Estimated population of Springfield, ... 36,730
Death-rate, ... 17.50


DEATH RATES OF CITIES.
LYNN
SPRINGFIELD
LAWRENCE
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35


DEATH RATES OF CITIES.
NEW BEDFORD
HOLYOKE
SOMERVILLE
SALEM
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35

Death-rates of Cities.

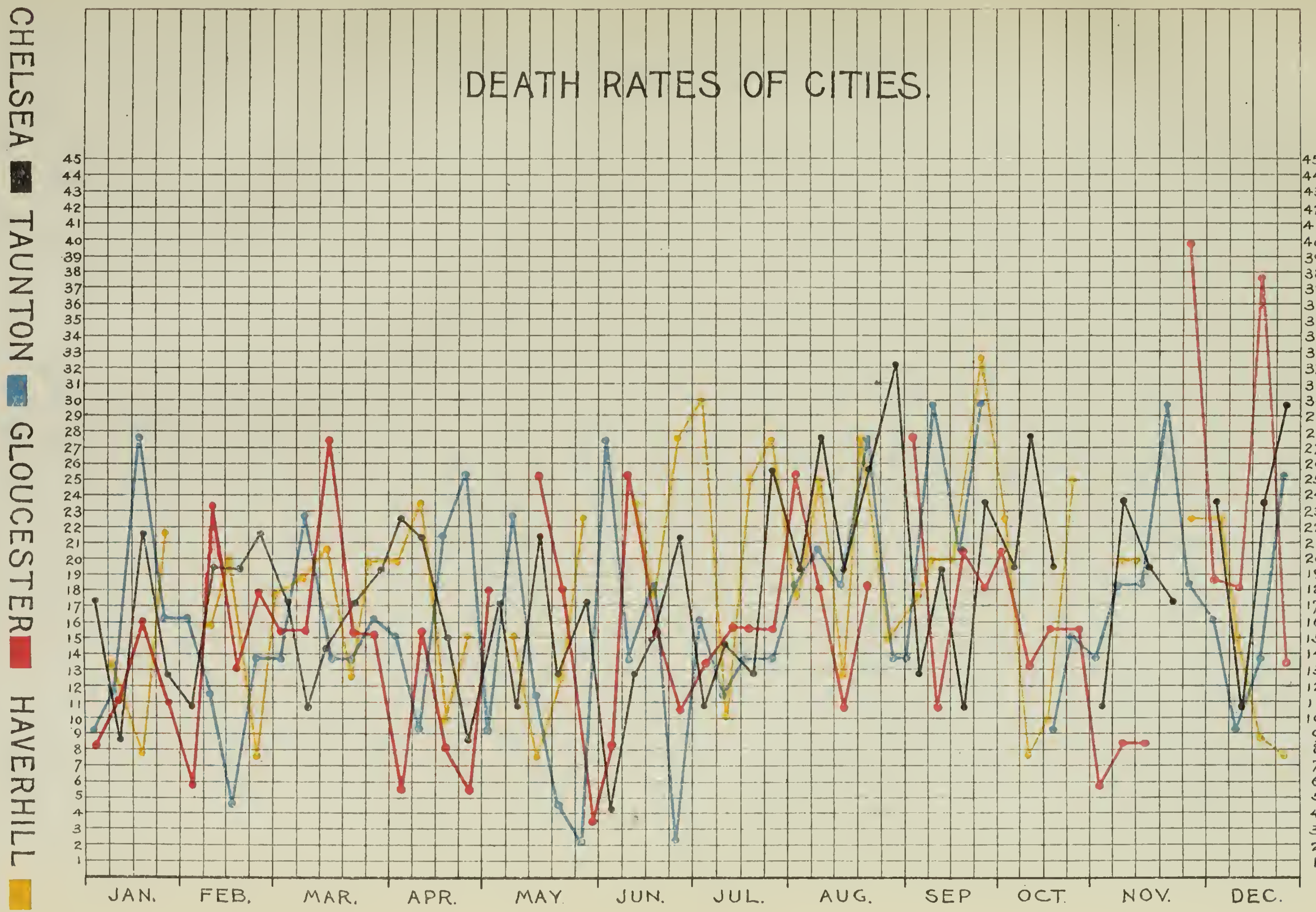
	Somerville.	Holyoke.	New Bedford.	Salem.		Somerville.	Holyoke.	New Bedford.	Salem.
Jan. 5, . . .	21.11	14.52	23.16	25.05	July 5, . . .	11.38	25.56	18.98	24.82
12, . . .	12.11	–	10.88	18.16	12, . . .	14.63	30.68	5.18	19.50
19, . . .	12.01	19.97	14.19	22.68	19, . . .	–	27.46	22.44	17.73
26, . . .	24.22	18.74	17.74	17.89	26, . . .	11.38	17.04	15.62	19.51
Feb. 2, . . .	13.84	18.16	23.06	25.05	Aug. 2, . . .	27.64	17.04	22.42	–
9, . . .	–	–	–	–	9, . . .	17.88	18.74	23.15	33.77
16, . . .	–	13.63	17.25	19.50	16, . . .	–	28.77	27.60	23.05
23, . . .	14.63	17.04	10.35	19.50	23, . . .	13.01	10.22	27.60	31.91
March 1, . . .	11.38	20.45	14.19	14.18	30, . . .	16.26	15.34	34.50	14.18
8, . . .	17.89	17.04	24.15	23.05	Sept. 6, . . .	–	25.56	25.87	23.05
15, . . .	16.26	18.74	14.83	30.14	13, . . .	24.39	25.56	25.86	24.81
22, . . .	9.76	17.04	27.60	23.05	20, . . .	–	11.93	13.70	19.50
29, . . .	16.26	17.04	25.75	15.96	27, . . .	14.64	–	29.33	21.28
April 5, . . .	8.13	13.63	20.70	12.41	Oct. 4, . . .	–	28.76	24.50	17.73
12, . . .	13.01	11.93	24.05	8.86	11, . . .	–	23.80	15.53	24.82
19, . . .	14.63	–	12.08	15.96	18, . . .	8.13	27.26	27.60	12.41
26, . . .	13.01	13.63	27.60	8.86	25, . . .	22.51	5.11	31.05	15.96
May 3, . . .	9.76	18.74	20.70	16.00	Nov. 1, . . .	–	18.74	15.53	17.73
10, . . .	8.13	6.11	10.35	24.82	8, . . .	–	27.26	15.53	7.09
17, . . .	–	13.63	32.78	12.41	15, . . .	–	–	17.25	21.28
24, . . .	19.51	13.63	12.08	17.73	22, . . .	–	17.04	20.73	12.41
31, . . .	17.88	22.45	13.80	17.73	29, . . .	–	25.56	13.80	23.05
June 7, . . .	11.38	18.74	22.43	23.05	Dec. 6, . . .	–	25.56	13.80	21.28
14, . . .	14.60	–	1.73	23.05	13, . . .	16.26	15.34	25.88	10.64
21, . . .	–	8.52	15.73	15.96	20, . . .	–	–	22.43	15.96
28, . . .	9.77	20.45	3.45	28.37	27, . . .	–	–	25.88	–

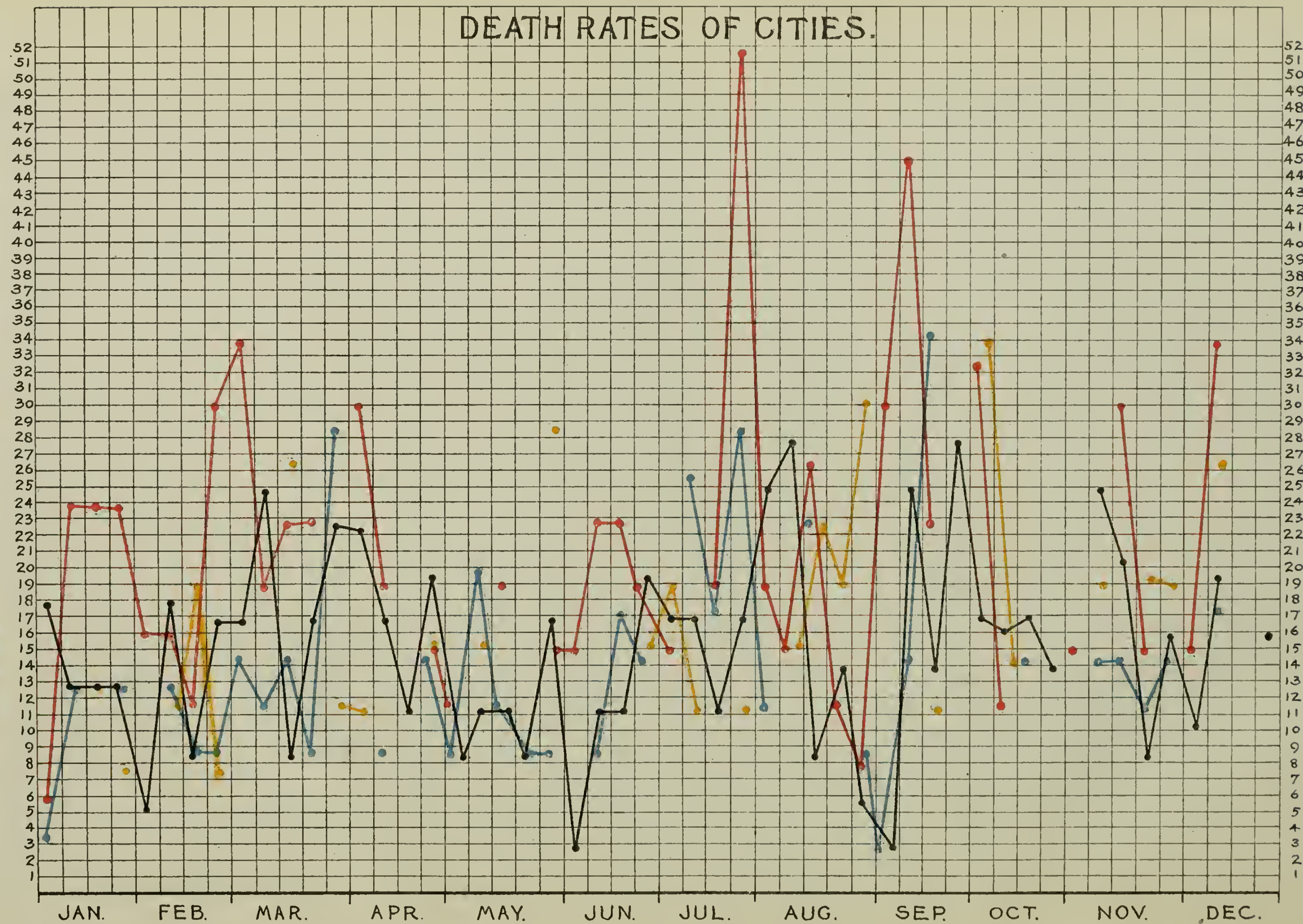
Estimated population of Somerville (1884), ... 28,980
Death-rate, ... 17.21
Estimated population of Holyoke (1884), ... 26,698
Death-rate, ... 20.86
Estimated population of New Bedford, ... 32,084
Death-rate, ... 19.29
Estimated population of Salem, ... 27,980
Death-rate, ... 20.90

Death-rates of Cities.

	Chelsea.	Taunton.	Gloucester.	Haverhill.		Chelsea.	Taunton.	Gloucester.	Haverhill.
Jan. 5, . .	17.25	9.12	7.56	–	July 5, . .	10.68	16.03	12.15	29.84
12, .	8 62	11.52	10 08	13.09	12, . .	14.75	11.46	14.88	9.95
19, . .	21.56	27.69	15.12	7.85	19, . .	12.82	13.75	14.58	24.87
26, . .	12.82	16.13	10.08	21.54	26, . .	25.63	13.75	14.58	27.38
Feb. 2, . .	10.78	16.13	5.04	–	Aug. 2, . .	19.22	18.33	24.30	17.41
9, . .	19.40	11.52	22.68	15.70	9, . .	27.67	20.62	17.01	24.87
16, . .	19.22	4.58	12.15	19.89	16, . .	19 22	18.33	9.72	12.44
23, . .	21.63	13.75	17.01	7.46	23, . .	25.63	27.49	17.11	27.36
March 1, . .	17.09	13.75	14.58	17.41	30, . .	32.04	13.74	–	14.72
8, . .	10.68	22.91	14.58	18.90	Sept. 6, . .	12.82	13.75	26 73	17.41
15, . .	14.19	13.75	26.73	20.31	13, . .	19.22	29.78	9.72	19.89
22, . .	17.09	13.75	14.58	12 44	20, . .	10.68	20.62	19.44	17.89
29, . .	19.22	16.04	14.28	19.90	27, . .	23.50	29.78	17.01	32.33
April 5, . .	23.50	15.04	4.86	19.90	Oct. 4, . .	19 22	–	19 44	22.38
12, . .	21.36	9.16	14.58	23.38	11, . .	27.77	–	12.15	7.46
19, . .	14.95	21.33	7.29	9.95	18, . .	17.22	9.16	14 58	9.93
26, . .	8.54	25.19	4.86	14.92	25, . .	–	15.04	14.58	24.87
May 3, . .	17.09	9.16	17.01	–	Nov. 1, . .	10.68	13.75	4.86	–
10, . .	10.72	22.91	–	14 92	8, . .	23.50	18.33	7.29	17 90
17, . .	21.36	11.46	24.30	7.46	15, . .	19.22	18.33	7.29	19 89
24, . .	12.82	4.58	17.01	12.34	22, . .	17.09	29.78	–	–
31, . .	17.07	2.29	2.43	22.38	29, . .	–	18.33	38.88	22.38
June 7, . .	4.27	27.49	7.29	–	Dec. 6, . .	23.80	16.04	17 44	22.28
14, . .	12.82	13.75	24 30	23.38	13, . .	10 68	9.16	17.01	14.92
21, . .	14.95	18.33	14.58	17.41	20, . .	23.49	13.75	36.45	8.46
28, . .	21.36	2 29	9.72	27.36	27, . .	29.70	25.21	12 15	7.46

Estimated population of Chelsea, ... 24,924
Death-rate, ... 18.33
Estimated population of Taunton, ... 23,182
Death-rate, ... 15.04
Estimated population of Gloucester, ... 21,336
Death-rate, ... 20.06
Estimated population of Haverhill, ... 21,130
Death-rate, ... 13.72


DEATH RATES OF CITIES.
45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
JAN. FEB. MAR. APR. MAY JUN. JUL. AUG. SEP OCT. NOV. DEC.
CHELSEA
TAUNTON
GLOUCESTER
HAVERHILL



NEWTON BROCKTON NEWBURYPORT FITCHBURG

Death-rates of Cities.

	Newton.	Brockton.	Newbury-port	Fitchburg.		Newton.	Brockton.	Newbury-port.	Fitchburg.
Jan. 5, . .	17.77	3.13	15.64	–	July 5, . .	16 61	–	14.88	19
12, . .	12.69	12.54	23.47	–	12, . .	16.61	25.53	–	11.40
19, . .	12.70	–	23.46	–	19, . .	11.07	17.02	18.51	–
26, . .	12.69	12.54	23.38	7.91	26, . .	16.61	28.37	51.21	11.40
Feb. 2, . .	5 07	–	15.64	–	Aug. 2, . .	24.91	11 35	18.61	–
9, . .	17 77	12.54	15.64	11.87	9, . .	27.68	–	14 88	15.20
16, . .	8.31	8.51	11.16	19.	16, . .	8.30	22.70	26.04	22 80
23, . .	16 61	8.51	29.77	7.60	23, . .	13.84	–	11.16	19.
March 1, . .	16.61	14.19	33.49	–	30, . .	5.54	8.51	7.44	30.40
8, . .	24.81	11.38	18.61	–	Sept. 6, . .	2.97	2.84	29.77	–
15, . .	8.30	14.19	22.33	26.60	13, . .	24.91	14.19	44.65	–
22, . .	16.61	8.51	22.33	–	20, . .	13.84	34.04	22.33	11.40
29, . .	22.45	28.35	–	11.70	27, . .	27.68	–	–	–
April 5, . .	22.14	–	29.77	11 40	Oct. 4, . .	16.61	–	32.05	34 02
12, . .	16.61	8.51	18.61	–	11, . .	16 01	–	11.16	14.20
19, . .	11.07	–	–	–	18, . .	16.61	14.19	–	–
26, . .	19.37	14.10	14.88	15.20	25, . .	13.84	–	–	–
May 3, . .	8.31	8.51	11.16	–	Nov. 1, . .	–	–	14.88	–
10, . .	11.07	19.86	–	15.20	8, . .	24 91	14.19	–	19.
17, . .	11.07	11.35	18 61	–	15, . .	20.38	14.19	29.77	–
24, . .	8.30	8.51	–	–	22, . .	8.30	11.35	14.88	19.40
31, . .	16.61	8.51	14 88	28.80	29, . .	15.84	14.19	–	19.
June 7, . .	2.77	–	14.88	–	Dec. 6, . .	10.07	–	14.88	–
14, . .	11 07	8.51	22.33	–	13, . .	19.38	17.12	33.49	26.60
21, . .	11.07	17.02	22.33	–	20, . .	–	–	–	–
28, . .	19.38	14.18	18.61	15.20	27, . .	16.61	–	–	–

Estimated population of Newton (1884), ... 19,206
Death-rate, ... 14.73
Estimated population of Brockton, ... 19,348
Death-rate, ... 14.67
Estimated population of Newburyport, ... 13,680
Death-rate, ... 20.83
Estimated population of Fitchburg, ... 14,786
Death-rate, ... 13.93

THE RELATION OF ILLUMINATING GAS TO PUBLIC HEALTH.

By Samuel W. Abbott, M.D., Health Officer.

A STUDY OF THE RELATIVE POISONOUS EFFECTS OF COAL AND WATER GAS.

By Professors W. T. Sedgwick and W. R. Nichols.

THE RELATION OF ILLUMINATING GAS TO PUBLIC HEALTH.

BY SAMUEL W. ABBOTT, M. D., *Health Officer.*

The impurities of the air which we breathe received the attention of the State Board of Health, and articles may be found bearing upon the subject, in its earlier reports; one of which contained the results of a series of experiments made for the determination of the amount of carbonic acid in the air, in its normal condition, and also in inhabited apartments.* In a later report a special paper was devoted to the subject of coal gas from heating apparatus, and its relation to life and health.†

With the same general object in view, the recent investigations of the Board have been conducted in order to show the relation of illuminating gas to life and health, especially under those conditions in which it is breathed, when escaping unconsumed from service-pipes, or burners, either by accident, or through the carelessness or ignorance of persons using it, or exposed to it.

Within the past ten years the greater frequency of deaths resulting from the inhalation of illuminating gas, has directed the attention of sanitary authorities to this subject.

The evidence presented as the result of this investigation consists, mainly, of the well-known facts relative to the properties of illuminating gases, and of their chief constituents, the actual experiments of the Board conducted for the purpose of ascertaining the relative effects of gases of different compositions, and the data obtained from cities and towns where illuminating gases are used.

* Second Annual Report of State Board of Health, 1871, p. 396.
† Tenth Annual Report of State Board of Health, 1879, p. 75.

The Composition of Illuminating Gas.

Two sorts of gas are mainly used at present for illuminating purposes in the United States. These are known popularly as coal gas, and water gas. Other forms are in use to a limited extent, made from petroleum, or its products. Coal gas, made from the destructive distillation of bituminous coal, and water gas by the decomposition of water and the addition to the product of the vapor of naphtha, have the following average composition: —

Coal Gas (*Nichols*).

Marsh gas,	40.0
Hydrogen,	34.8
Nitrogen,	14.2
Carbonic oxide,	7.0
Illuminants,	3.4
Oxygen,	0.5
Carbonic acid,	0.1

London Gas (*Coal*) (*Letheby*).

Light carburetted hydrogen,	39.5
Hydrogen,	46.0
Condensible hydrocarbons,	3.8
Carbonic oxide,	7.5
Carbonic acid,	0.6
Aqueous vapor,	2.0
Oxygen,	0.1
Nitrogen,	0.5

Water Gas (*Remsen*).

Carbonic acid,	0.3
Illuminants,	12.82
Carbonic oxide,	28.25
Marsh gas,	21.45
Hydrogen,	30.3
Nitrogen,	6.85

Water Gas.

Municipal Gas Light Co., N. Y. (*Prof. Wurtz*).

Hydrogen,	38.05
Marsh gas,	11.85
Carbonic oxide,	29.40
Carbonic acid,	0.10
Oxygen,	0.10
Nitrogen,	3.71
Olefines, (vaporized)	9.29
Paraffines,	7.50

Of the constituents of illuminating gas the greater part are not positively poisonous gases, the illuminants or hydrocarbons, marsh gas, hydrogen and nitrogen being nonsupporters of life, in consequence of the absence of the important element oxygen.

Marsh gas has been credited with poisonous action. Its action in this direction is weak and probably unimportant, and instances of death from it are not on record. According to Dr. B. W. Richardson, 35 per cent. of it in air is requisite to produce anæsthesia.* It exists abundantly in many coal mines, and men habitually work in mixtures of it with air, such mixtures occasionally being of an explosive strength, and at the same time breathed by the miners without danger, or serious effects upon respiration. The Davy lamp was invented for the protection of persons living, breathing and working in such an atmosphere.† The illuminants may also have a slightly poisonous action.

Of other constituents, carbonic acid is a more poisonous gas when present in considerable quantity. In the normal condition of the atmosphere it is everywhere present in the proportion of about 3 to 4 parts per 10,000. The process of purification removes it so completely from illuminating gas, as to render the small residuum of little practical importance as a noxious constituent. The same is also true of sulphuretted hydrogen, a poisonous gas which is also removed by the process of purification.

There remains to be considered the carbonic oxide. This gas is colorless, almost odorless, slightly soluble in water, and burns with a pale blue flame.‡

Carbonic oxide is easily generated when coals or charcoal are burned with insufficient access of air. The gas is usually received into the system by means of the respiratory organs. It is doubtful if it gains access to the blood in other and more indirect modes. It is not readily soluble in the blood, though more soluble in it than in water. The small quantity

* Asclepiad, July, 1885, p. 272.

† Leblanc. Annales de Chém. et Phys., 3d series, vol. 5, p. 239: Eulenberg. Handbuch der Gewerbe Hygiene, p. 368.

‡ Ziemssen's Cyclopædia, Boehm, vol. 17, p. 456; also Sir H. Davy, Taylor, Christison, Devergie, Fownes, Briand, Ure, Berzelius, Fehling, Tourdes, Woodman and Tidy.

absorbed by the blood suffices to cause extensive and serious changes in its properties. The researches of Bernard, of Meyer, and of Hoppe-Seyler have shown that carbonic oxide displaces the oxygen from the blood, and enters into combination with the coloring matter in such a manner as to render it incapable of absorbing more oxygen.

The quantity of carbonic oxide requisite to produce a fatal result varies considerably with different individuals. The experiments of the Board have an important bearing upon this point.

The subjective symptoms of poisoning are quite uniform. The first symptom noticeable is a burning feeling in the skin of the face; this is quickly followed by giddiness and headache, gradually becoming more intense. The headache is usually associated with a subjective feeling of strong pulsation in the temporal arteries. Occasionally in the early stage there is also nausea and oppression at the stomach. Often these are attended with other subjective symptoms, such as noises in the ears, imperfect vision, etc., indicating a transition to perfect loss of consciousness. There is also frequently distress of mind, anxiety and excitement, and at this stage insensibility often attacks the victim, who falls to the floor unconscious, if standing or attempting to walk. Consciousness ceases.

The subjective symptoms noted in cases of recovery are more variable. The most marked is a feeling of weakness and fatigue, often lasting for several days. Headache, a want of clear conception, and general obscurity of the mental faculties are also noticed. In cases which end fatally the victims either never wake from coma, or their wakening is transitory and imperfect.

The *objective* phenomena are mainly as follows: In the early stages the external surface of the body shows congestion and redness, especially in the face. The conjunctivæ are injected. The mucous membranes are usually of a bright red. In the later comatose stage the skin is usually pale, and becomes livid toward the end of life. Herpetic and other eruptions are also occasionally present.

The respiratory functions are not always prominently affected. Usually the initial stages of dyspnœa are succeeded

by a comatose condition in which sometimes it would appear as if there were no hindrance to respiration, which goes on in a regular rhythm, death occurring without convulsions. There can be no doubt, however, that convulsions do occasionally take place.*

According to Siebenhaar and Lehmann,† "towards the end the breathing is, in almost all cases, quickened and even seems to be tolerably energetic and as if accomplished with great exertion. But in general the breathing . . . becomes less rapid and more superficial; later, there are constantly increasing pauses in the breathing . . and finally there follows after one such inspiration the long pause which is succeeded by death, imperceptibly and without visible spasms or convulsions."

Bronchitis, hemoptysis and pneumonia with or without pleurisy, occasionally follow carbonic oxide poisoning.

The arterial pulse is full and quickened for awhile, and later becomes less powerful and in the stage of coma can scarcely be felt.

The temperature is usually considerably diminished (about 2° to 2.5° C.)

There is usually more or less vomiting in the early stage.

Nervous system: Anæsthesia of the cutaneous surface is common, also paralysis of voluntary and of involuntary muscles.

The bodies of the dead exhibit an unusual resistance to putrefaction. Broad and irregular bright red spots appear on the surface. A similar rose-red coloration is often met with in the internal organs, muscles and serous membranes. The coloring of the blood is not constant.

There is usually a uniform fullness of blood in the parenchymatous organs, and injection of capillary vessels. Ecchymoses are also common in the pleuræ, peritoneum, pericardium and meninges.

Of the poisonous nature of carbonic oxide gas there can be no question. Chemists of older as well as of more recent periods, from the time of Priestley and Sir Humphrey Davy down to the present day, have united in pronouncing it one of

* Boehm in Ziemssen, vol 17, p. 465. Briand, Medicine Legale, p 367.

† Die Kohlendunstvergiftung, Dresden, 1858.

the most poisonous of gaseous products. Among the principal authorities which may be cited are Regnault,* Chenot,† Letheby,‡ Bloxam,§ Bernard,|| Eliot and Storer,¶ Leblanc,** Werker,†† Eulenberg, ‡‡Richardson.§§

The frequent occurrence of death either by accident or by suicide in Paris from inhalation of carbonic oxide evolved by the combustion of charcoal in small, closed apartments, is well known. Such cases are of much rarer occurrence in the United States.

The character of carbonic oxide as a constituent of illuminating gas, and the conditions under which it becomes dangerous to life and health.

In an excellent paper written by Dr. E. S. Wood, entitled "Illuminating Gases, their relation to Health," the subject, was treated with special reference to the effects of gas upon human beings, during the process of manufacture, purification and combustion. At that time (1876) water gas had not been introduced anywhere in the United States on a large scale; the mortality from asphyxia by the inhaling of illuminating gas was very small, and hence the question had attracted but little attention. The remarkable increase in such fatality from the breathing of unburned gas within the past few years has given greater prominence to the question, and hence the present investigation has been conducted.

It might be supposed, and has been theoretically stated, that the *danger resulting from the breathing* of unburned illuminating gas, either mixed or unmixed with air, is *directly proportionate* to the amount of carbonic oxide contained in the gas. Other noxious constituents may be reckoned as practically out of the question, either in conse-

* Regnault's Chemistry, Philadelphia, 1852, p. 321, vol. 1.
† Comptes Rendus, Fr. Academy, 1854, p. 735.
‡ Chemical News, April 19, 1862, p. 212.
§ Bloxam's Chemistry, London, 1860, p. 78.
|| Les effets des substances toxiques.
¶ Chemistry, 1871, p. 338.
** Annales de Chem. et Phys., 1842, 3d series, vol 5, pp. 223 68.
†† Lehrbuch der praktischen Toxicologie, 1869, p. 81.
‡‡ Handbuch der Gewerbe Hygiene, 1876, p. 344.
§§ Journal of the Society of Arts, 1884.

quence of their reduction to a minimum by the process of purification, or on account of the comparatively small amount present.

Practically, as shown by the experiments of the Board, the danger increases in something more than a direct ratio, when all the conditions of exposure are taken into consideration, such as the size of rooms, the rate of escape of gas, the length of time of exposure, such as a night's rest of 8 or 10 hours, etc.

Cases of death are on record from the inhalation of gas containing from 5 to 9 per cent. of carbonic oxide. Such cases, however, have occurred under extraordinary conditions, such as a small, tightly closed apartment, a burner fully open, or a broken gas-pipe, and seldom otherwise. On the other hand deaths have ensued from breathing a gas containing 25 to 30 per cent. of carbonic oxide, under ordinary conditions.

Certain practical questions arise with reference to asphyxia, from illuminating gases, suggested by the method adopted by Briand in dealing with the question of asphyxia from carbonic oxide.

1. *The size of rooms in which accidents and deaths from asphyxia have resulted.*

By far the greater number of deaths resulting from asphyxia from gas inhalation in the United States, up to the present time, have occurred in small rooms in hotels, boarding-houses, tenement-houses and a few private houses, and with the exception of a few cases which were suicidal, death resulted from carelessness, neglect or ignorance, the victim having either blown out the gas, or left it escaping in some other way on retiring to bed at night. Without doubt intemperance has occasionally contributed to the fatal result.

Suicides have occurred in the following manner: — One man crawled into an ice-box and shut the cover, having first conducted the gas into the box through a piece of rubber tubing (Dr. Raymond's report, page 40). In another case a man placed a piece of rubber tubing over a burner and inhaled the pure gas, which, in this case was coal gas (Dr. Raymond's report, page 58). In both of these instances it is

quite clear that a fatal result might be reached much more rapidly than under ordinary circumstances.

In another case a man unscrewed the tips of several burners, turned on the gas and allowed a free escape from them all together. He was found dead upon the floor.

We have made several careful measurements of rooms in which deaths have occurred.

One bed-chamber in a private house in Middletown, Conn. This apartment had two small doors and one window, also a bedstead, chair, table and washstand. The cubic air capacity of the room was 600 feet. (See case reported below.*)

The gas-burner was a common 6-foot fish-tail burner at the side of the room, and when the room was entered in the morning, the burner was found partially open, about two thirds. The gas was water gas.

We also measured two rooms in the Van Dyke House, a small hotel in New York City, one of which was 7 feet 2 inches, by 12 feet 6 inches, by 11 feet=985 cubic feet. A death occurred in this room.

Another room in this house in which a death occurred from asphyxia by gas measured 9 feet 2 inches, by 8 feet 8 inches, by 11 feet 10 inches=940 cubic feet.

At another hotel, the Occidental, in which a similar death occurred, the cubic capacity of the room was as follows: 7 feet 5 inches, by 9 feet 2 inches, by 10 feet=680.

* The victim in this case, Christine Wedel, a Swede, aged 25, was in good health previous to the accident. She was robust and vigorous, weighed about 160 pounds, could walk, run or lift weights without difficulty.

She had not probably been used to illuminating gas before her employment in the family where she died, a house of one of the professors at Wesleyan University. Mrs. W., the professor's wife, had instructed her how to use the gas. This girl had been ironing clothes late in the afternoon and had some friends in the kitchen, with whom she was laughing and talking until she retired to her room about 10 o'clock. Mrs. W. found her about seven in the morning, dead in bed; there was no evidence of a struggle, and on the bedclothes there was considerable vomitus. The gas-burner was turned partially off and gas was still escaping; it was a small side-light near the window. The room had one window, two doors, a bed, chair, chest and wash-stand, and contained about 600 cubic feet of air space. There was no special provision for ventilation. Mrs. W. opened the window, when she first discovered the servant dead.

Two physicians were summoned, both of whom were of the opinion from the appearance of the deceased, that she had been dead at least three or four hours. The coroner's jury which was summoned rendered, a verdict of accidental death "by asphyxia from the inhalation of illuminating gas through negligence in properly shutting it off when she retired.'

At another small hotel or boarding-house, in which the rooms were very small, and quite uniform in size, and in which two deaths from gas occurred together in one room and in one bed, this room measured 7 feet 10 inches, by 7 feet 10 inches, by 8 feet 6 inches = 521 feet.

In a short walk apartments were visited and examined in five buildings in which thirteen deaths from asphyxia had occurred within the past five years. All were supplied with water gas.

This question of the cubic air-space of apartments assumes greater importance, when it is known that a few hundred feet added to the capacity of a room will prove the safety of the person who is exposed to gas-poisoning within it. In other words the added amount of air produces just the amount of dilution necessary for safety, and the victim although unconscious may be resuscitated.

A room of only 520 feet capacity is unfit for human habitation, even with the absence from all danger of gas-poisoning, unless some opening for adequate ventilation is provided, and always kept open. Too often are ventilators permanently closed by rust, transoms nailed, and other openings covered to prevent the access of fresh air. One has not far to search in any city or town to find inhabited rooms of smaller capacity than those named above.

2. *The Rate of Escape of Gas.* The ordinary rate of a fish-tail or bat-wing burner varies according to the pressure, the exact size of the opening of the burner, and its condition as to cleanliness, or freedom from foreign material, such as dust, tar, etc. The rate may be stated as from 3½ to 7 feet per hour.* It may be considerably more than this under greater pressure and with the cock fully open. When gas is blown out, and allowed to escape, through ignorance as to its character, an occurrence not unfrequent in hotels where farmers, and others from country towns, not accustomed to its use, are lodged, it is not common to find it turned on to its full capacity.

In cases of suicide it is common to find the gas escaping at the maximum limit of the burner. In one case the tip had been removed, evidently to allow a freer escape of gas.

* Paton. Brit. Cycl., 9th edition, Article *Gas*.

The entire fixture was removed in another case, and gas allowed to escape from the full size of the bore of the pipe, at many times the rate of an ordinary burner. In such a case it is clearly evident that a fatal result must ensue at a much earlier period, than under ordinary circumstances, in consequence of the more rapid poisoning of the air.

The rate of escape of unburned gas would determine the amount present in an apartment in a given time, if the apartment were perfectly tight, or so nearly air-tight that no more air would escape, than would compensate for the amount of gas introduced. Practically such a room does not exist.

In such a room, air-tight, or sufficiently so to allow of escape of air only as fast as gas is admitted, containing 600 cubic feet of air, a six-foot burner would in one hour supply an amount of gas equal to one per cent. of the cubic contents, and in ten hours ten per cent. The one-burner experiments of the Board were mainly conducted at a rate of six-feet per hour, the meter being carefully watched from hour to hour, and the rate of escape regulated to that amount.

3. *Length of Exposure.* Accidental cases of gas-poisoning occur almost exclusively during the unconscious period of sleep. Allowing eight hours as the average time of sleep of adults, it is probable that most fatal cases occurring in closed apartments have been exposed at least as long as eight hours. In the case of persons exposed to gas containing a large amount of carbonic oxide, there can be no doubt that a fatal result has taken place in much shorter periods. Where the escape of gas has been detected by its odor, in halls and adjoining apartments, people have often been resuscitated after brief exposures of an hour or more. Such cases are of frequent occurrence, but are not so fully known to the public, since no requirement exists for notification of them as in the case of death from the same cause. In the latter case the matter is one of medico-legal interest, and becomes a matter of record by the coroner. The statutes relative to registration of deaths also require a certificate of the cause of death.

Many of the New York cases are reported as having retired to bed about 10 P.M., and were found dead about 7

or 8 o'clock on the following morning. In a few cases the victims were living but died in a few hours after they were discovered. Others were cold, and in a few *rigor mortis* had occurred, showing that death had taken place several hours before they were discovered.

The frequent occurrence of deaths and accidents at hotels in New York has proved a source of serious trouble and annoyance, especially to such as have small rooms, and are patronized by people of an ignorant and careless class. So great is this annoyance that in some of them it is common to find the caution or danger signal displayed in *large* letters, *Danger! turn off the gas*, where an illuminating gas is used, which has a large proportion of carbonic oxide.

Such unusual precautions were not deemed necessary before the introduction of a more poisonous agent.

Since the introduction of water gas it has also become necessary to use other precautions relative to the safety of guests, in the class of hotels and boarding-houses referred to. In an examination of several of these places I found that special openings had been made from halls and corridors into sleeping-rooms, for the purpose of detecting the escape of gas. In one hotel these openings were about three inches in diameter and closed with a slide, a man being employed to examine each room by means of the openings, with reference to the existence of escaping gas; his visits were made several times through the night. Similar precautions were found to have been adopted at another hotel.

Nothing of the sort was deemed necessary prior to the introduction of a new and more poisonous illuminating agent.

4. *It is not necessary that a room should be perfectly tight*, as an essential condition for the production of asphyxia from illuminating gas. Practically such a condition with reference to any room used for human habitation would be impossible. It has been repeatedly shown that the wood, plaster, bricks, paper and other material of which the walls are made in rooms as commonly constructed, are more or less pervious to the passage of air and of gases. The experiments of the Board have very clearly demonstrated the same fact. Joints in floors and about doors and windows, cracks

in ceilings and walls, keyholes, etc., all contribute to the same result. The ordinary gas burner (bat-wing) admits of the introduction of gas through a narrow slit, a fraction of a millimeter only in width, while scarcely any room exists in which there are not many cracks, keyholes, or other apertures of much larger dimensions, through which the escape of air and gas may continually take place. It often happens that these various modes of escape of gas prove the safety of the unconscious victim, by warning others of the escape of gas, or by allowing a freer dilution of the inner air of the apartment. But it is also true that more than 90 per cent. of deaths by gas poisoning occur in those hours of the night from 9 P.M. to 6 A.M., when by far the greater portion of the population are asleep, and hence the odor is not detected until recovery is impossible.

In Middletown, Conn., a city of 12,000 inhabitants, accidents from the inhalation of illuminating gas have been of much more frequent occurrence since the introduction of water gas than before. In one small hotel I was shown four rooms, in each of which a guest had been partially asphyxiated, within the past three or four years. These persons were resuscitated with difficulty. One of the rooms in which such an accident happened, measured 2,400 cubic feet in capacity. On the authority of a citizen of that place, we learn that headaches have become quite common as a result of the leakage from the gas now used. Three deaths have occurred in this town since 1880 from this cause.

In Dover, New Hampshire, a city of similar size, three deaths have occurred from the same cause, since the introduction of water gas in that place.

In Pullman, Illinois, having about 9,000 inhabitants, four deaths have occurred from the same cause, since its introduction in 1881.

The exact data with reference to their experiments will be found detailed minutely in the following report of the experts employed by the Board.

These results were confirmed by careful observation, samples of the air of each room being taken at stated periods in each experiment, and submitted to analysis.

With reference to this point several rooms were examined in which deaths had occurred from asphyxia, by gas inhalation. These rooms, with one exception, had no transoms. Each had a single door and window, and were not unusually tight rooms.

5. *What quantity of carbonic oxide in the air is essential to the production of a fatal result by asphyxia? and how long exposure in hours or minutes is necessary.*

Under this topic may be considered the effect of undiluted carbonic oxide, of undiluted, and of diluted illuminating gas.

(*a.*) Cases of death from undiluted carbonic oxide occurring among men are never met, the gas in its pure state being only found in small quantities as experimentally prepared.

Recently the gas has been employed by Dr. B. W. Richardson for the rapid destruction of animal life in a successful manner, being produced by the combustion of charcoal, and introduced into small lethal chambers containing the animals.* The exact proportion of carbonic oxide in the air of chambers was not stated, but it would be practically impossible, by the method proposed, to exclude all the air, and to substitute a pure atmosphere of carbonic oxide in its place. In the frequent cases of suicide and charcoal gas poisoning in Paris in closed apartments, it is also impossible that the entire atmosphere of any apartment should have been substituted by carbonic oxide.

As an illustration of the effects of carbonic oxide as evolved from burning charcoal, may be cited a singular case given in *Briand's Medicine légale*, wherein a young workman, meditating suicide, and also desirous of leaving a useful tribute to science, as to the effects of carbonic oxide, shut himself into a small room with a lamp, a candle and a match. He noted upon a paper, his feelings at intervals of ten minutes. He lighted his charcoal furnace at 10.15. At

* In a list of twenty-two gases and vapors Dr. R., selects four as useful for the purpose named: carbonic oxide, chloroform, carbon bisulphide, and coal gas; of these four he gives decided preference to carbonic oxide. In 1883 and 1884 nearly 7,000 dogs were rapidly and painlessly destroyed by it in London. (*Journal of Society of Arts, 1884.*)

10.30, he had a severe headache, with accelerated pulse. At 10.40, his candle was extinguished, the lamp still burning; intense throbbing of blood-vessels of the head, tendency to sleep, pulse 80. At 10.50, a sensation of smothering, "strange notions arise before me, I can scarcely breathe — I have feelings of madness; 10.60, my sight fails, my light is going out;" 10.62, writing becomes illegible.

(*b*.) Exposure to the effects of undiluted illuminating gas. Like the former instance of exposure to undiluted carbonic oxide, cases of exposure of human beings to an atmosphere of pure illuminating gas are rare.

The case of William Zimmermann, of New York city, who died in December, 1881, must have been one of exposure to an atmosphere very highly charged with illuminating water gas. This case, as detailed from official records, was as follows: W. Z., aged 30, laborer at Municipal Company's gas works, was sent up to open man-hole plate to let out gas from top of holder. This plate covers a hole at least $2\frac{1}{2}$ feet in diameter, and allows a stream of gas of that size to escape. At 2.50 P.M., he went up to close the opening, but did not return. The report states that he was discovered about 7 P.M., at which time he was found insensible, with his feet toward the man-hole. He died at 8 o'clock the following morning.

The verdict of the jury stated that death resulted from inhaling illuminating gas, and censured the company for neglect to employ two men to do the work which was assigned to this workman.

The cases of Louis Ottersen, who died in New York Aug. 6, 1881, a suicide, who shut himself up in an ice-box after stopping all holes and letting in water gas through a rubber tube; and also that of Frank Hahse, a suicide, who died in Boston, March 19, 1883, by inhaling coal gas through a rubber tube were both cases of exposure to an atmosphere of nearly pure gas.

In neither of these cases was the time between exposure and death exactly known, nor the amount of gas present in the air.

(*c.*) Exposure to diluted illuminating gas. As has been stated under (*b*), cases of exposure to an atmosphere of undiluted gas are rare, and when such do occur, they take place under peculiar circumstances and are either cases of suicide or of some extraordinary mode of exposure, as in the case of Zimmermann cited above. From the numerous cases collected from coroners' records and other sources of a similar character, it is evident that a fatal issue has been reached in at least nine-tenths of the number, under conditions much like the following:

A small bed-chamber (of 500 to 1,500 cubic feet capacity), usually with tightly closed door and windows and no provision for ventilation; an exposure usually in the night, in the hours of sleep, for at least two or three hours and usually a longer period; a burner allowing escape of gas at rate of five to ten feet per hour, either escaping at its full capacity, or in some cases at a rate, considerably less. The place usually a hotel of the poorer class, a boarding or lodging house, and occasionally a private residence. The victim, usually an emigrant, a visitor from a country district, unacquainted with the use of gas, and in a private residence a servant occupying a small bed-chamber. The gas being blown out and allowed to escape, or the burner being provided with an imperfect stop, the valve is turned too far, being supposed to be shut. In some instances the victim has been known to have been intoxicated at the time of retiring, and the chances of accident were increased by this condition.

In a room containing 800 cubic feet capacity, which is about the average size of rooms in which fatal results have taken place, a 6-foot burner (i. e. allowing escape of 6 feet per hour), would introduce in 8 hours, 48 cubic feet, a little more than 6 per cent. of the air of the room. By careful experiment, it is proved that at least more than half of this amount escapes, leaving less than 3 per cent. in the room at the end of 8 hours.

Of this amount (say 3 per cent.) in the case of coal gas, from 5 to 8 hundredths would be carbonic oxide, or from 15 to 25 hundredths of one per cent. of the air of the room, an amount sufficient to produce headache, nausea, malaise and

other symptoms of like nature, but very rarely a fatal result.

In the case of water gas escaping at the same rate and filling a smaller room to the amount of 3 per cent. at the end of 8 hours, from 25 to 35 hundredths would be carbonic oxide, or nearly one per cent. of the air of the room, an amount which is inevitably fatal to healthy adults after an exposure of from 4 to 12 hours.

It appears from these observations as to cases which have occurred, and also from the experiments of the Board, that in ordinary cases an exposure to coal gas would produce in a night's sojourn in a small room, such as has been described, severe and unpleasant symptoms, and possibly insensibility, with a probability of resuscitation and complete recovery.

An exposure to water gas under similar conditions would usually be followed by death in less than 8 hours.

Many of the most potent narcotic drugs exhibit this danger limit in a very striking manner.

The statistics as to fatality from the inhalation of illuminating gas, in New York, are conclusive as to this point, that a gas containing from four to five times more carbonic oxide than another, is dangerous to the life of persons accidentally or intentionally inhaling it in a still greater ratio.

6. *Two or more persons being exposed to a poisonous atmosphere charged with illuminating gas, one dies at an earlier hour than the other, or others. What causes lead to the difference in the result?* Age, sex, health or vigor of constitution are modifying conditions; a young child, or a very old person succumbing sooner than one in the prime of adult age.

As between the sexes, men survive longer than women. In the Brooklyn cases Nos. 24 and 25, Thomas, aged 71, and Susanna Wallace, aged 61, man and wife, were found lying side by side in bed, asphyxiated, Mrs. Wallace being dead and the husband dying soon after.*

In the New York cases, Nos. 92 and 93, Hugh and Margaret Concannon, aged respectively 23 and 22 years, occu-

* See Dr. Raymond's report.

pied a room in Astor Place Hotel. They retired about 12 P. M. and were found at seven the next morning, Mrs. Concannon being dead and her husband just alive; he died soon after.

In the cases of poisoning from simple carbonic oxide, a similar observation has been made. The cases of Mr. and Mrs. Bragdon, cited in the 10th Report of the State Board of Health of Massachusetts are in point.* Mrs. Bragdon, although a robust and healthy woman and in apparently a condition of greater vigor and strength than her husband, yet succumbed before him.

On the other hand cases are occasionally on record with a contrary result, as in those of William and Mary Meekin, aged 24 and 18 years (82 and 83 New York cases),† at Eagle Hotel in New York, who were both found insensible from escaping gas, the key being turned half way. The man died first in this instance.

Position of the body, with reference to its height from the floor of the room does not appear to influence a fatal result so much as was formerly believed. Illuminating gas is lighter than atmospheric air, but where diffused through an apartment it is found to exist in the lower strata of air in the same proportion as in the upper. Practically, therefore, it makes but little difference whether a person exposed to it lies upon the floor, upon a bed, or at a still higher level.

Proximity to a door, window, or a crevice admitting a current of air would modify the saturation of the air and hence prolong the period to a fatal result.

Supposed period of death (Casper), or length of time elapsing between first exposure and death. This cannot be ascertained definitely from observations upon the human subject. Approximate estimates may be made by the usual signs of death, such as the temperature of the body as compared with its normal temperature in life, and also the existence or absence of *rigor mortis*. In the majority of instances of death from inhalation of illuminating gas the

* 10th Report, 1879, page 75.

† Dr. Raymond's Report.

victim is found within 24 hours after death when observations are more readily made than at a later period.

In the case of the servant who was found dead in her room at Middletown, Conn., at seven A. M., she having retired at ten P. M. the evening before, appearances indicated the occurrence of death as early as three A. M., after five hours' exposure to an atmosphere partially saturated with water gas, in a room of 600 feet capacity.

In the Board's experiment with animals in a room of similar size, with water gas, death took place at variable periods from one and a half hours to seven and a half hours.

The observations and the experiments of the Board conclusively demonstrate that practically the danger increases more rapidly than would be indicated by the increase in the amount or percentage of carbonic oxide present.

All illuminating gases are complex mixtures of several gases in variable proportions. In a careful résumé of the subject in Ziemssen's volume on Poisons, Boehm says: "We may practically disregard the admixtures. . . . Multiplied experiences have taught us that the danger of their mixtures depends undoubtedly on the carbonic oxide present, and that apart from this, the gaseous mixtures produce very trifling symptoms."

For the purpose of obtaining more definite information relative to the actual effects of illuminating gas upon the life of human beings exposed to it, a circular of inquiry was addressed to the health authorities of 216 cities and towns in the United States having a population of more than 10,000.

This circular embraced the following data:

Population of city or town.

Kind of gas used for illumination.

Deaths reported and from what kind of gas.

Replies were received from the following places: Allentown, Penn.; Altoona, Penn.; Atlanta, Ga.; Auburn, Me.; Auburn, N. Y.; Augusta, Ga.; Baltimore, Md.; Boston, Mass.; Beverly, Mass.; Brookline, Mass.; Brooklyn, N. Y.; Binghamton, N. Y.; Bloomington, Ill.; Burlington, Iowa;

Brockton, Mass.; Cambridge, Mass.; Camden, N. J.; Canton, Ohio; Cedar Rapids, Iowa; Charleston, S. C.; Chicago, Ill.; Chicopee, Mass.; Cincinnati, Ohio; Cleveland, Ohio; Columbia, S. C,; Concord, N. H.; Cumberland, Md.; Danbury, Conn.; Dover N. H.; Davenport, Iowa; Danvers, Mass.; Dedham, Mass.; Denver, Col.; Des Moines, Iowa; Detroit, Mich.; Easton, Penn.; Erie, Penn.; Fitchburg, Mass.; Fall River, Mass.; Fort Wayne, Ind.; Galesburg, Ill.; Grand Rapids, Ill.; Harrisburg, Penn,; Halifax, N. S.; Hamilton, Ont.; Hartford, Conn.; Haverhill, Mass.; Lancaster, Penn.; Lawrence, Mass.; Memphis, Tenn.; Manchester, N. H.; Marlboro', Mass.; Middletown, Conn.; Mobile, Ala.; Nashua, N. H.; New Albany, Ind.; New Bedford, Mass.; New Brighton, N. Y.; New Haven, Conn.; Newport, Ky.; Newport, R. I.; Newton, Mass.; New Orleans, La.; New York, N. Y.; Norwich, Conn.; Norfolk, Va.; Ogdensburg, N. Y.; Orange, N. J.; Ottawa, Ont.; Paterson, N. J.; Peabody, Mass.; Petersburg, Va.; Pittsburg, Penn.; Portland, Me.; Portsmouth, N. H.; Poughkeepsie, N. Y.; Plymouth, Mass.; Providence, R. I.; Pullman, Ill.; Quincy, Ill.; Racine, Wis.; Richmond, Va.; Rochester, N. Y.; Rockford, Ill.; Rock Island, Ill.; Rome, N. Y.; Sacramento, Cal.; Salem, Mass.; Salt Lake City, Utah; San Francisco, Cal.; Schenectady, N. Y.; Somerville, Mass.; St. Paul, Minn.; Savannah, Ga.; Syracuse, N. Y.; Scranton, Penn.; Taunton, Mass.; Terre Haute, Ind.; Toledo, Ohio; Waltham, Mass.; Watertown, N. Y.; Wilmington, Del.; Woburn, Mass.; Worcester, Mass.; Yonkers, N. Y.; Zanesville, Ohio.

From these replies it appears that 189 deaths have been recorded as due to inhalation of illuminating gas in the 108 cities, from which returns have been received, in the twenty years and six months included in the returns.

Of these 189 deaths, 40 are recorded as due to coal gas in the twenty and one-half years of record; 45 as due to water gas in the seven and one-half years of record since its introduction, and one to a mixture of coal and water gas, leaving 103 in which the noxious cause was not specified.

These occurred mainly in New York City and in reference

to the Report of Health Commissioner Raymond, (p. 32 a.) which brings the record up to May 29, 1883, it is there stated that 21 deaths were due to coal gas, up to that date, and 44 to water gas, and in four the cause was not ascertained. The cases due to water gas occurred in a period of four and one-half years only.

It also appears that in three large cities in which water gas has been introduced, New York, Baltimore and Brooklyn, with a population of over two million people, there had been 16 deaths from the inhalation of illuminating gas previous to the introduction of water gas, in a period of 13 years, or 1.2 per year.

In the same cities for the remaining seven and one-half * years, after the introduction of water gas there were 120 deaths due to inhalation of illuminating gas or 16 per year, an increase of more than twelvefold in the deaths from this cause, while the population had not doubled in the same period.

To carry the comparison still further: The two cities, Boston and Baltimore, are quite similar in the number of their population (about 400,000 each).

In Boston there have been but four deaths attributable to illuminating gas in 20 years.

In Baltimore, in the same period, there have been 19 deaths from the same cause, 17 of which have occurred in 1883, 1884 and 1885.

The former city uses coal gas for illumination, and the latter water gas.

It would naturally be expected that under similar conditions in other respects, the fatality would be greater in Boston, on account of its location in a colder climate, where doors and windows are closed more tightly through the winter season.

The consumption of coal gas in England is very large. The following table gives the consumption for 1880 in the United Kingdom: —†

* Seven and a half years for New York, but a shorter period for Baltimore and Brooklyn.

† Mulhall's Dictionary of Statistics. London, 1884, page 218.

	London.	Other Towns.	Total.
Cubic feet, . . .	18,100,000,000	53,500,000,000	71,600,000,000
Cubic feet per inhabitant, ...	4,750	3,100	3,400

Notwithstanding this enormous consumption it does not appear that deaths have been frequent in the United Kingdom, as the following statistics show from the Registrar General's Report of England and Wales for the years 1879, 1880, 1881, 1882 and 1883.

*Population of England and Wales.**

By census of 1881, ...	25,974,439
Estimated for 1883, ...	26,770,744

England and Wales.† Deaths from Asphyxia by Gas and Coal Gas, 1879–83.

	Males.	Females.	Total.
1879, ...	1	3	–
1880, ...	6	2	–
1881, ...	–	1	–
1882, ...	3	1	–
1883, ...	5	2	–
	15	9	24

Of this number, 7 were specified as deaths from gas, simply, and 17 from coal gas. It is not certain that the former were from illuminating gas.

Other deaths were specified in the same reports as caused by charcoal gas, nitrous oxide, carbonic acid gas, sulphuretted hydrogen and mephitic gas, and were not enumerated among those considered as illuminating gases.

* Registrar General's Report. 1883.

† Registrar General's Report, England and Wales, 1879, '80, '81 '82, and '83.

So far as can be ascertained these cases occurred in the following registration districts of England: —

South Midland,	1
Eastern,	1
West Midland,	1
North Midland,	1
North Western,	5
Yorkshire,	3
Total,	12

The location of the remaining twelve was not specified.

The districts named above include the populous cities and towns of Liverpool, Manchester, Birmingham, Sheffield, Bradford, Leeds and Leicester.

In strong contrast to these figures are the results found in three of the populous cities of the United States where water gas has been introduced. The same years are selected for comparison.

Deaths from Asphyxia by Illuminating Gas in Baltimore, Brooklyn and New York, 1879–83.

YEAR.	Baltimore.	Brooklyn.	New York.	Total.
1879,	–	–	1	1
1880,	–	–	11	11
1881,	1	3	15	19
1882,	–	5	19	24
1883,	6	2	14	22
	–	–	–	77
Population: Census of 1880,	332,190	566,689	1,206,590	2,105,469

Records from several other large cities of the United States, including Chicago, Philadelphia, Cincinnati, San

Francisco and New Orleans, with reference to this matter, cannot be obtained, in consequence of imperfect methods in the registration of causes of death, the terms "Accident," "Suffocation" and "Asphyxia" being employed without specifying the exact cause.

An examination of the reports of companies with reference to the comparative amounts of coal gas and water gas used in the United States, shows that at no time has the consumption of water gas ever equalled that of coal gas.

The Use of Gas for other Purposes beside that of Illumination.

For several years illuminating gas has been employed to a limited extent for heating, cooking and other domestic purposes, and more recently, in some cities, corporations have been formed which manufacture non-luminous gas for these purposes alone. While its use for the purposes of cooking, when conducted in well-ventilated apartments not used as bed-rooms or chambers, is not specially liable to cause death or accident from asphyxia, its employment for the purpose of heating small apartments which have no provision for ventilation cannot be too severely condemned.

Recent improvements have been made in the construction of gas-heating stoves by which the products of combustion are conveyed into a chimney or flue by means of a funnel or stove pipe provided for that purpose. At the same time it is claimed as a special advantage that these stoves can be used either with or without the funnel.

The consumption of gas required for these stoves is greater than that of a single burner, and the vitiation of the air by the products of combustion is also correspondingly greater, and hence the danger from asphyxia in case of an accident or careless use of a heating-stove in a bed-chamber is also greater than that from a single burner used for illumination only.

Four of the deaths recorded in the reports from Brooklyn and New York were from the use of gas-heating stoves.

Thomas and Susannah Wallace of Brooklyn, and John F.

Gantz and J. B. Osborne of New York City, lost their lives in those cities from this cause.

Three deaths from the use of gas-stoves, in small rooms, are also reported, and included in the deaths in Providence, R. I., in 1873, 1876 and 1877, one in each year.

Remedies for the Prevention of Accidents.

1. The removal of the carbonic oxide from illuminating gas. This plan has been proposed and is certainly a very desirable method of remedying the trouble. It has not however been carried out on a large scale at any place in the United States and it is a question whether any process is practicable, which will successfully and economically produce the desired result.

2. The use of automatic burners which would cause the gas to ignite immediately on escaping. Such a plan would be of much service, but would not apply to such cases as were due to leakage from pipes.

3. Limiting the minimum size of sleeping apartments and requiring thorough ventilation.

4. The enforcement of the statute relative to the amount of carbonic oxide in gas. In this connection it is a question worth considering, whether the limit may not be reduced to seven or eight per cent., instead of ten, as it now stands.

The following is the law bearing upon this point in Massachusetts.

[Public Statutes of Mass., Chap. 61, Sect. 14.]

The gas of every company supplying more than fifty consumers shall be inspected at least twice a year, and one additional inspection shall be made for every four million cubic feet of gas supplied by each company; but the gas of no company shall be inspected oftener than once a week. All such inspections shall be made by the inspector or his assistant, and one-fourth at least of all such inspections shall be made by the inspector. The gas shall be tested for illuminating power by means of a disc photometer, and, during such test, shall be burned from the burner best adapted to it, which is at the same time suitable for domestic use, and at as near the rate of five feet per hour as is practicable. When the gas of any company is found on three consecutive inspections to give less light than fifteen standard English candles, or to contain more than twenty grains of sulphur or ten grains of ammonia per hundred cubic

feet of gas, or more than ten per cent. of carbonic oxide, or any sulphuretted hydrogen, a fine of one hundred dollars shall be paid by such company to the city or town supplied by it. When during the test the consumption of gas varies from five feet per hour, or the candle from one hundred and twenty grains per hour, a proportionate correction shall be made for the candle power.

Summary of fatal cases from inhalation of illuminating coal gas.

FROM COAL GAS.		FROM COAL GAS.	
Allentown, Penn.,	1	Newport, R. I.,	1
Baltimore, Md.,	2	Paterson, N. J.,	2
Brooklyn, N. Y.,	3	Providence, R. I.,	5
Boston, Mass.,	4	Richmond, Va.,	3
Davenport, Iowa,	3	Rochester, N. Y.,	1
Denver, Col.,	1	Salt Lake City,	2
Galesburg, Ill.,	1	Toledo, Ohio,	3
Lawrence, Mass.,	1	Zanesville, Ohio,	1
New Bedford, Mass.,	2		
New Haven Conn.,	4	Total from coal gas,	40

Summary of fatal cases from inhalation of illuminating water gas.

Baltimore, Md.,	17
Brooklyn, N. Y.,	12
Dover, N. H.,	3
Middletown, Conn.,	3
Pullman, Ill.,	4
Scranton, Penn.,	6
	45
Mixture of 40% coal gas with 60% of water gas,—	
Toronto, Ont.,	1
Not specified in returns,—	
Quincy, Ill.,	1
New York City,	102
	103
From coal gas,	40
water gas,	45
mixture,	1
Not specified,	103
Total,	189

Summary by years.

Year.	Deaths.	Year.	Deaths.
1865,	0	1877,	1
1866,	0	1878,	6
1867,	0	1879,	2
1868,	3	1880,	13
1869,	4	1881,	26
1870,	2	1882,	31
1871,	7	1883,	30
1872,	2	1884,	33
1873,	2	1885 (6 mos.),	18
1874,	3	Date not specified,	3
1875,	2		
1876,	1	Total,	189

TABULAR STATEMENT OF DEATHS FROM INHALATION OF ILLUMINATING GASES.

United States and Canada. Cities and Towns.	Population.	Kind of Gas.	1865.		1866.		1867.		1868.		1869.		1870.		1871.		1872.		1873.		1874.		1875.		1876.		1877.		1878.		1879.		1880.		1881.		1882.		1883.		1884.		1885.	
			Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.
Allentown, Penn.,	20,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
Altoona, Penn.,	25,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Atlanta, Ga.,	50,000	Coal and water gases,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Auburn, Me.,	10,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Auburn, N. Y.,	26,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Augusta, Ga.,	36,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Baltimore, Md.,	417,220	Coal and water gases,	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	6	–	3	–	8
Beverly, Mass.,	10,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Binghamton, N. Y.,	20,000	Water gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Bloomington, Ill.,	20,000	Water gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Boston, Mass.,	390,406	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	1	–	–	–	–	–	1	–
Brockton, Mass.,	20,783	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Brookline, Mass.,	9,195	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Brooklyn, N. Y.,	665,602	Coal and water gases,	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	2	3	–	2	–	4	–	–
Burlington, Iowa,	24,000	Mixture of water and coal gases,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cambridge, Mass.,	59,660	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Camden, N. J.,	55,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Canton, O.,	20,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cedar Rapids, Iowa,	18,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Charleston, S. C.,	52,286	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chicago, Ill.,	632,100	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chicopee, Mass.,	11,528	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cincinnati, O.,	325,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cleveland, O.,	200,000	Coal gas, with about 3 per cent. naphtha gas added.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Columbia, S. C.,	12,000	Water gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Concord, N. H.,	14,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cumberland, Md.,	12,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Danbury, Conn.,	15,000	Water gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Davenport, Iowa,	23,784	Coal gas,	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Danvers, Mass.,	7,048	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dedham, Mass.,	6,641	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Denver, Col.,	55,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Des Moines, Iowa,	36,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Detroit, Mich.,	165,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dover, N. H.,	11,693	Water gas since 1881,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	1		
Easton, Penn.,	15,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

United States and Canada. Cities and Towns.	Population.	Kind of Gas.	1865.		1866.		1867.		1868.		1869.		1870.		1871.		1872.		1873.		1874.		1875.		1876.		1877.		1878.		1879.		1880.		1881.		1882.		1883.		1884.		1885.	
			Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.	Illuminating Coal Gas.	Illuminating Water Gas.
Erie, Penn.,	36,000	Coal and natural gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fitchburg, Mass.,	15,375	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fall River, Mass.,	56,863	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Fort Wayne, Ind.,	–	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Galesburg, Ill.,	14,000	Coal gas,	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Grand Rapids, Mich.,	45,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Halifax, N. S.,	35,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Hamilton, Canada,	40,000	. . . .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Harrisburg, Penn.,	35,000	Water gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Hartford, Conn.,	46,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Haverhill, Mass.,	21,795	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lancaster, Penn.,	30,000	Water gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lawrence, Mass.,	38,825	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
Memphis, Tenn.,	62,335	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Manchester, N. H.,*	36,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Marlborough, Mass.,	10,941	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Middletown, Conn.,	12,000	Water gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	2	–	–	–	–	–	–	–	–
Mobile, Ala.,	31,295	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nashua, N. H.,	13,840	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
New Albany, Ind.,	70,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
New Bedford, Mass.,	33,393	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–
New Brighton, S. I., N. Y.,†	13,580	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
New Haven, Conn.,	75,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–
New Orleans, La.,	234,000	Water gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Newport, R. I.,	20,339	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Newport, Ky.,	28,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Newton, Mass.,	19,759	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
New York, N. Y.,‡	1,397,395	Coal and water,	–		–		–		2		1		1		7		1		1		1		–		–		–		2		1		11		15		19		14		19		7§	
Norfolk, Va.,	25,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Norwich, Conn.,	24,000	Coal and naphtha gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ogdensburg, N. Y.	11,400	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Orange, N. J.,	15,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ottawa, Canada,	–	. . . .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Paterson, N. J.,	62,000	Water gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–
Peabody, Mass.,	9,530	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Petersburg, Va.,	22,000	Coal gas,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

* No record. † Water gas is just about being introduced. ‡ In the replies from New York it is not specified whether the deaths were from coal or water gas. § Six months ending June 30, 1885.

MORTALITY FROM CHOLERA, CHOLERA INFANTUM, DIARRHŒA AND DYSENTERY, IN MASSACHUSETTS, — 1848-1884, — BY COUNTIES.

YEAR.	Barnstable.				Berkshire.				Bristol.				Dukes and Nantucket.			
	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.
1847 and 1848,*	–	–	–	–	–	–	–	–	3	4	5	93	–	–	2	46
1848,‡	–	12	1	70	1	1	2	27	4	8	-	150	-	1	2	30
1849,	27	3	1	84	9	2	8	72	41	10	2	91	5	–	–	31
1850,	2	6	5	47	2	6	11	65	–	8	14	55	1	1	–	16
1851,	1	2	-	52	1	2	3	64	3	10	3	219	–	–	1	10
1852,	1	4	–	29	4	2	2	57	1	15	4	96	–	–	5	9
1853,	–	4	3	13	3	7	7	50	4	23	7	77	-	4	6	15
1854,	7	1	1	16	10	3	4	40	173	38	8	83	2	–	1	11
1855,	2	9	3	17	4	7	10	57	5	39	12	103	1	-	2	15
1856,	1	4	14	38	2	1	10	51	2	15	14	105	1	3	4	1
1857,	1	-	1	14	5	2	7	31	4	18	8	103	–	1	–	4
1858,	1	1	2	18	2	2	5	30	3	30	9	69	–	–	2	12
1859,	1	1	-	7	2	11	1	28	5	33	13	92	–	1	2	1
1860,	2	7	5	10	1	5	5	21	4	77	20	48	–	–	1	4
1861,	5	10	3	13	–	18	2	19	4	75	18	46	–	4	–	2
1862,	2	4	6	14	2	13	9	12	2	35	43	47	–	3	2	2
1863,	5	16	10	60	2	13	41	49	5	69	57	97	–	–	1	7
1864,	2	4	12	42	3	14	18	29	4	49	41	133	–	10	–	4
1865,	–	5	7	27	4	10	19	92	2	75	25	147	–	5	–	5
1866,	3	3	4	23	13	21	11	51	5	63	24	97	1	2	-	4
1867,	1	1	2	13	1	19	4	22	6	45	14	44	–	2	5	1
1868,	5	2	5	14	3	20	18	43	4	113	24	62	1	1	2	1
1869,	2	9	5	10	2	11	9	41	5	64	14	37	-	1	2	1
1870,	–	13	4	10	7	40	19	36	13	85	17	40	–	1	1	5
1871,	1	5	1	2	1	37	3	20	2	80	26	33	–	1	1	–
1872,	1	15	2	7	3	97	20	48	6	257	38	66	–	7	–	–
1873,	–	8	3	5	1	51	11	29	9	211	43	33	-	5	–	4
1874,	2	19	4	10	3	53	2	23	6	205	26	27	–	1	2	4
1875,	–	12	2	9	6	85	6	18	1	252	37	46	–	2	–	1
1876,	1	12	3	11	5	44	4	13	12	263	22	37	–	–	1	1
1877,	1	11	1	7	2	46	3	21	4	230	28	20	1	3	–	–
1878,	2	10	–	5	4	32	6	10	8	129	39	73	–	2	–	2
1879,	–	3	3	1	2	21	9	5	10	128	33	65	–	2	–	1
1880,	–	8	3	4	4	60	7	8	15	238	32	38	1	4	4	2
1881,	–	9	3	–	2	51	13	11	3	204	38	53	–	2	1	8
1882,	–	16	2	14	2	71	7	11	16	258	57	60	–	8	3	3
1883,	1	3	1	7	4	58	13	15	5	186	43	29	–	2	2	1
1884,	–	15	1	4	7	81	9	8	7	262	42	31	–	9	1	2

YEAR.	Essex.				Franklin.				Hampden.				Hampshire.				Middlesex.			
	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.
1847 and 1848,*	17	15	34	142	–	–	2	5	2	4	21	10	2	1	5	8	4	91	42	394
1848,‡	12	60	5	410	–	2	1	65	1	11	4	144	1	5	2	122	8	91	21	454
1849,	48	32	8	285	1	3	4	78	89	33	6	221	17	16	2	125	202	91	37	378
1850,	8	38	16	105	4	2	5	64	1	12	14	82	–	6	4	108	10	59	34	123
1851,	2	46	18	291	1	–	1	53	5	25	2	104	3	21	–	60	5	91	45	248
1852,	10	45	11	111	–	2	1	50	5	19	2	64	–	11	–	66	8	100	30	102
1853,	11	83	30	182	1	4	5	38	3	16	4	53	–	15	3	60	18	112	62	156
1854,	30	59	35	162	6.	1	2	32	22	25	3	46	3	9	2	61	136	139	78	220
1855,	13	86	51	205	1	8	5	34	2	11	17	35	4	11	5	26	13	158	88	208
1856,	10	60	32	134	4	6	5	28	9	22	10	41	2	10	2	39	8	118	71	129
1857,	3	39	29	91	4	8	1	23	–	26	7	26	1	8	4	32	10	121	16	156
1858,	14	70	31	87	3	7	1	20	3	27	16	99	–	13	2	15	9	156	24	129
1859,	16	96	21	57	1	2	–	13	2	31	8	89	1	28	3	35	15	169	17	81
1860,	13	120	50	61	–	15	5	18	4	32	14	12	4	19	4	22	22	257	45	60
1861,	7	146	30	113	–	8	3	19	3	51	13	19	–	28	3	14	16	253	53	83
1862,	6	89	31	59	2	13	5	16	2	41	29	18	3	21	3	33	16	227	42	63
1863,	15	109	62	160	1	13	29	44	5	61	25	108	1	19	31	50	13	211	86	139
1864,	14	150	67	205	1	10	9	41	3	40	26	79	4	34	10	55	28	291	87	185
1865,	7	155	55	309	2	22	4	38	3	52	28	68	4	25	6	73	13	230	63	162
1866,	19	164	28	148	–	13	3	20	9	65	20	44	6	19	9	31	43	231	66	146
1867,	4	145	33	110	–	9	4	22	8	39	14	30	1	14	6	10	9	208	54	151
1868,	19	187	28	110	1	15	1	9	4	52	15	59	5	22	7	23	31	367	54	105
1869,	12	244	32	71	1	21	4	16	11	77	22	39	1	23	3	22	17	320	41	65
1870,	18	229	35	39	2	23	6	30	8	94	26	21	5	48	9	31	13	460	81	62
1871,	12	206	26	59	–	11	–	10	13	91	26	15	1	30	9	21	13	358	93	58
1872,	26	525	31	75	1	36	1	18	12	211	29	27	3	62	11	33	19	688	124	92
1873,	20	384	32	70	–	19	2	11	5	210	9	17	4	52	7	14	18	563	92	104
1874,	7	302	52	36	4	33	–	11	9	112	15	49	–	43	4	17	20	448	98	51
1875,	10	326	34	33	2	22	1	16	9	138	16	14	7	75	3	15	18	498	78	80
1876,	17	314	33	47	1	18	3	7	6	137	18	10	1	34	5	7	12	367	39	69
1877,	9	268	30	65	2	18	4	12	7	94	11	10	1	41	5	13	8	331	47	142
1878,	12	261	33	47	–	14	–	2	3	107	25	8	1	23	7	9	8	348	53	158
1879,	8	223	35	26	2	14	–	5	5	70	13	10	3	20	4	5	10	265	41	86
1880,	11	262	47	46	1	25	4	5	10	134	29	7	3	42	8	3	15	431	61	59
1881,	10	252	61	45	1	17	5	4	7	133	24	13	1	37	6	18	13	378	44	57
1882,	24	297	68	58	1	25	9	3	8	145	35	15	3	39	7	15	16	351	52	49
1883,	13	189	56	35	2	27	1	22	4	151	31	11	2	32	6	15	16	359	61	43
1884,	7	249	57	26	4	34	7	9	8	160	31	16	2	31	9	9	15	362	64	27

YEAR.	Norfolk.				Plymouth.				Suffolk.				Worcester.				Totals for State.			
	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.
1847 and 1848,*	7	11	32	99	3	14	10	22	†	–	1	11	8	23	86	198	46	172	245	1,074
1848,‡	4	21	6	207	4	11	6	98	–	1	–	22	6	44	3	336	41	268	53	2,135
1849,	52	35	19	168	13	17	6	96	658	62	113	316	26	56	3	510	1,188	360	209	2,455
1850,	7	20	4	91	11	4	8	49	10	36	50	152	9	54	7	231	65	252	172	1,188
1851,	11	26	4	96	4	17	4	78	21	77	58	142	7	66	9	257	64	383	148	1,674
1852,	6	39	10	69	1	16	4	45	11	73	57	124	13	51	6	196	60	377	132	1,018
1853,	7	43	45	61	5	21	12	58	34	136	36	145	4	67	23	138	90	535	243	1,046
1854,	50	38	6	74	19	21	10	58	283	94	57	154	24	100	14	202	765	528	221	1,159
1855,	7	57	48	42	2	32	28	80	11	234	22	151	5	94	24	158	70	746	315	1,131
1856,	6	29	25	48	2	14	15	54	2	213	26	127	6	60	34	135	55	555	262	930
1857,	2	51	19	43	3	20	13	23	2	280	20	93	3	57	10	76	38	631	135	715
1858,	6	70	23	27	2	19	9	38	11	238	29	98	12	87	22	110	66	720	175	752
1859,	4	74	13	–	2	32	26	31	8	249	29	64	9	104	18	77	66	831	151	612
1860,	5	110	22	36	7	43	12	25	26	274	62	70	11	119	29	54	99	1,078	274	441
1861,	9	143	29	49	6	58	24	35	20	344	58	55	9	128	36	67	79	1,266	272	532
1862,	15	83	20	34	1	31	12	30	26	240	97	75	8	100	41	76	85	900	340	479
1863,	13	129	72	111	5	43	59	91	32	352	109	106	24	129	89	134	121	1,164	671	1,156
1864,	6	108	53	105	1	42	38	80	14	286	139	122	15	160	89	106	95	1,198	589	1,186
1865,	8	117	43	119	3	43	32	86	25	266	127	164	13	149	55	758	84	1,154	464	1,548
1866,	12	89	21	54	–	28	13	31	62	273	89	140	19	107	16	160	192	1,078	304	949
1867,	4	75	26	57	2	26	6	16	15	243	88	81	13	140	14	101	64	966	270	658
1868,	3	90	16	19	5	33	2	22	25	487	104	116	11	172	17	102	117	156	293	685
1869,	7	80	19	21	4	33	10	23	21	367	122	72	12	174	22	63	95	1,424	305	481
1870,	4	80	19	27	3	40	4	22	20	532	214	69	14	269	22	79	107	1,914	457	471
1871,	10	92	9	21	5	45	4	19	33	531	130	62	5	231	16	69	96	1,718	344	389
1872,	8	145	12	31	4	82	10	23	32	773	152	54	22	356	34	90	157	3,254	464	564
1873,	4	93	15	20	2	60	9	13	32	627	115	58	11	270	15	57	106	2,553	353	435
1874,	3	104	9	12	3	59	4	15	28	701	155	55	10	242	27	56	95	2,322	398	366
1875,	6	98	18	24	–	76	9	38	27	722	183	92	11	300	26	51	94	2,606	413	437
1876,	1	70	7	14	5	56	10	26	19	553	170	98	11	219	20	77	91	2,087	335	417
1877,	–	82	10	38	1	37	4	18	16	576	181	159	8	190	19	75	60	1,927	343	580
1878,	1	57	13	23	5	33	5	16	14	391	160	221	13	166	24	28	68	1,573	365	602
1879,	4	50	8	10	5	20	7	19	23	392	186	109	5	141	31	30	77	1,349	370	372
1880,	–	77	14	15	2	38	8	17	35	536	218	131	19	263	45	60	116	2,118	480	395
1881,	5	54	10	15	3	49	9	16	17	477	206	97	6	198	38	23	68	1,861	458	360
1882,	6	64	9	24	2	65	7	24	35	532	191	81	23	288	41	41	136	2,159	488	398
1883,	5	87	17	16	1	43	9	14	18	563	239	87	13	241	37	41	84	1,941	516	336
1884,	2	51	12	10	1	43	7	17	45	533	240	57	10	251	42	38	108	2,081	522	254
Totals,																	5,088	49,620	12,549	30,380

* Year ending April 30, 1848.

† 1848. Suffolk reports were from part of Chelsea only, none from Boston.

‡ Eight months ending Dec. 31, 1848.

A STUDY OF THE RELATIVE POISONOUS EFFECTS OF COAL AND WATER GAS.

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The recent extensive employment for illuminating purposes of the so-called "water" gas, derived from the decomposition of steam by the action of incandescent coal and enriched with the vapor of naphtha, has excited a vigorous discussion of the question whether this gas is, or is not, more dangerous to the public health when distributed for the purposes of illumination, than the ordinary "coal" gas derived from the destructive distillation of bituminous coal. Up to the present time, although opinions, chiefly *a priori*, have been freely expressed in the affirmative, and especially in the negative, in answer to the question, very little experimental evidence has been available.

In view of the possibility of the general substitution of water gas for the coal gas now in common use in Massachusetts, the question has assumed a large public importance, and accordingly, under the instruction and direction of the State Board of Health, Lunacy and Charity, an investigation was undertaken by us, in the hope of obtaining facts which might serve to answer the question.

A summary of the work done and of the results reached was reported to the Board, by it submitted to the General Court, and afterwards printed as a "preliminary report" in February, 1885. (Senate Document No. 60, 1885.)

The present paper includes in substance everything to be found in the preliminary report, while the results there summarized are here considered in detail; the methods employed

and the detailed history of the various experiments being also fully given in an appendix.

Illuminating gas, as ordinarily supplied to consumers, is a poisonous gas, whether it be made from coal, wood or other organic substances (coal gas, wood gas, etc.), or derived from coal and water by their action upon each other at high temperatures (water gas); but it is never a single gas of uniform composition. It is always a mixture of several gases, and it is the mixture known as coal gas which must be compared with the mixture known as water gas. The composition of these mixtures, as might be supposed, is not always exactly the same, but varies somewhat from day to day in the case of the same kind of gas; and very considerably in the case of the same kind of gas made in different places by different methods. These variations of composition must not be lost sight of, but they are generally within narrow limits so that the expression "coal gas" or "water gas" stands for a tolerably definite substance or mixture. For example, according to the report of the State Inspector of Gas and Gas Meters for Massachusetts for 1884,* the composition of a number of specimens of coal gas from different towns and cities of this State was as follows: —

	Average.	Varying —	
		From	To
Illuminants,	6.19	4.55	8.03
Marsh gas,	37.41	35.53	41.98
Hydrogen,	46.38	39.53	52.12
Carbonic oxide,	5 53	3.19	6.74
Nitrogen,	3.72	0.85	9.66
Oxygen,	0.25	0.00	1.81
Carbonic acid,	0.52	0.00	1.78

From the same authority we quote the following figures, showing the composition of water gas in various places.

* House Document No. 50, 1885.

	Average.	Varying —	
		From	To
Illuminants, ...	12.48	10.12	17.81
Marsh gas, ...	20.55	13 58	26.51
Hydrogen, ...	36.34	27.77	43.99
Carbonic oxide, ...	27.46	24.47	31.52
Nitrogen, ...	2.56	0.92	5.72
Oxygen, ...	0.26	0.00	0.95
Carbonic acid, ...	0.35	0.00	1.17

In like manner the properties of illuminating gas may be spoken of, although it is clear that such properties must originate in those of the component gases; and since differences exist in the composition of the mixtures known as illuminating gas it need not be surprising if differences exist in the properties of these mixtures. Clearly, the poisonous qualities of illuminating gas constitute no exception to this rule, and differences in this particular, if any there be, must arise from differences of composition. These might affect conceivably either the nature of the constituent gases (qualitative differences) or might be limited to differences in their relative amounts (quantitative differences), or both; but in the case in hand, quantitative rather than qualitative differences are to be dealt with.

It is freely admitted that both gases are poisonous — precisely as it is granted that they are qualitatively alike; but although their quantitative relations are also well known there has been hitherto no general agreement as to their relative poisonous properties. This is the more remarkable because the principal poisonous constituent is unusually well known, and its properties have long been recognized. For, whatever importance be attached to the physiological actions of the other constituents of coal and water gas, it still remains true, that the only really poisonous substance which is present in any considerable proportion in either gas, is carbonic oxide.

All the gases in these mixtures (excepting oxygen, which is occasionally present in very small proportion) are irrespirable, *i. e.*, they cannot supply the place of oxygen for breathing purposes, and if breathed undiluted will produce speedy death from suffocation.

But besides this negative power which it shares with the other constituents of illuminating gas, carbonic oxide is conspicuous for poisonous properties which are peculiarly its own. It exerts, for example, a special direct action upon the living blood-cells of the animal body, depriving them of the power of performing their normal functions, and if present in sufficient quantity speedily undermines the functions of the whole body.

On the assumption that carbonic oxide is the only essentially poisonous substance in both coal gas and water gas, it might seem that the question which we were endeavoring to answer could have been settled by experiments upon carbonic oxide itself. Investigations of this sort have, indeed, been made by a number of experimenters, and the only point of disagreement between them is as to the effects of very small amounts of carbonic oxide. It is agreed that carbonic oxide is a powerful poison, but it is still a question whether or not the smallest quantities are wholly ineffective.

For our purposes, however, there could be no doubt as to the desirability of experimenting with the two gases as they actually flow from the pipes of the companies which manufacture and distribute them. This was the more necessary because it has been suggested that other gases besides carbonic oxide, occurring in illuminating gas, may be operative in making up its total poisonous quality. We have given the suggestion its full value and have arranged our experiments accordingly. At the same time the close resemblance of the symptoms observed in poisoning by illuminating gas to those produced by carbonic oxide poisoning should have due weight, as should especially the results of Gruber,* who removed the carbonic oxide from illuminating gas and then mixed the purified gas so obtained with air in various proportions. In atmospheres of this kind, containing sometimes as much as eleven per cent. of the gas freed from carbonic

*Archiv für Hygiene, I (1883), 168.

oxide, animals (mice) remained for hours, exhibiting merely some stupefaction, and quickly recovered when taken out.

Without denying, therefore, to the other constituents their proper physiological effects when breathed with air in a mixture of which they form a large proportion, it is probably true that carbonic oxide is the only component of illuminating gas whose poisonous qualities are at present of practical importance to the public health.

At the outset an experimental room (Room I, Appendix) was built to imitate in size and closeness an ordinary sleeping-room of medium size. It was originally our intention to place in this room animals of different kinds (in order, by learning the effects upon animals in general,—since it was not possible to experiment upon men, — to infer concerning the effects upon man himself), and then to introduce into it, through one or more burners, at a known rate, coal gas or water gas in successive experiments. This room was readily supplied with coal gas, and it was supposed that it would not be difficult to obtain and control a supply of water gas sufficient for our use. But in this we were disappointed, and after several attempts and many annoying delays it became evident that it would be easier and in some respects better to visit places supplied with water gas and there make comparative experiments.

Accordingly, we visited Middletown, Conn., and Athol, Mass., both of which were supplied with water gas, and there made several experiments. Afterwards we remodelled the original room supplied with coal gas — at Newton Centre, Mass. — and there concluded our experiments upon animals. More recently, one of us has made a special experiment in a room in his own house, and has also studied the influence upon coal gas of its passage through artificial soils. For the special details of most of these experiments reference must be made to the appendix to this paper. There also will be found the description of the methods employed in sampling, in analysis, etc. In the present place it will suffice to state the results to which our experiments have led us, and also certain practical conclusions which naturally follow.

I. *With ordinary gas fixtures it is generally difficult to get more than three per cent. of illuminating gas into an ordinary room. By using one burner alone it is difficult to exceed one per cent.*

The explanation of these facts is very simple and depends upon the rapid leakage and diffusion — the " natural " ventilation — which is all the time going on through the walls, ceiling and floor, and through the " cracks " about the doors and windows. The rate at which this goes on keeps pace in a general way with the amount of inflow, increasing as the inflow increases, so that no extensive accumulation can take place. Rather, a balance, so to speak, is struck if the inflow be constant, between the amount flowing in and that flowing out, so that a tolerably definite quantity is always in the room. But as the outflow increases more rapidly in proportion, in order to raise to any great extent the amount that shall remain in the room, it is necessary that a very much larger amount shall flow in. For example: with six feet per hour it is difficult to keep one per cent. in a small room, but it would be much more difficult to reach two per cent. with twelve feet per hour, and quite impossible (under ordinary circumstances) to reach six per cent. with thirty-six feet per hour.

II. *With coal gas it is a matter of some difficulty to get into an ordinary apartment through the ordinary burners gas enough to produce upon healthy animals distinctly poisonous effects. With water gas, on the contrary, it is comparatively easy to get into an ordinary apartment, through the ordinary burners, gas enough to produce poisonous and even fatal effects.*

This is not because water gas flows in more freely, or accumulates in any way, in the room. For the percentages present under similar circumstances, after the lapse of the same time, do not materially differ with the two gases. The only explanation which we have been able to discover is, that under the same circumstances water gas is considerably more poisonous than coal gas.

There is little doubt that in order to produce poisoning by either gas, a certain percentage of carbonic oxide must be present. And upon this view the facts are readily inter-

preted, for water gas contains enough of carbonic oxide to supply under these circumstances a dangerous amount while coal gas does not. It must certainly be accounted a curious fact, though it appears to be true, that in the combination of ordinary apartments, ordinary gas fixtures and ordinary coal gas, there happens to be comparative safety, while in the combination of ordinary apartments, ordinary gas fixtures and ordinary water gas, there is comparative danger.

III. *It does not follow that because one illuminating gas contains three, four or five times as much carbonic oxide as another it is therefore only three, four or five times as dangerous to life.*

A little consideration will show that no such simple relation can possibly exist. For it is not conceivable that a gas containing ninety per cent. of carbonic oxide wouldbe exactly twice as dangerous to inhale as one with forty-five per cent.: both would be extremely dangerous. Nor would pure carbonic oxide be merely one thousand times as dangerous, if inhaled, as a mixture of air and carbonic oxide in which the latter amounted to 0.1 per cent.: it would be infinitely more dangerous. Again, a mixture of air and illuminating gas might be inhaled for a short time, which contained only 0.001 per cent. of carbonic oxide, but to say that this was precisely half as dangerous as a mixture containing 0.002 per cent. would be obviously absurd: neither would be noticed at all.

From the experiments of others, and from our own work, there is no doubt that atmospheres containing eight per cent. or more of either coal gas or water gas will destroy life very quickly, and that atmospheres containing 0.2 per cent. or less of either gas may be breathed for a long time without producing distinctly poisonous effects. But, between these limits, there is for each gas a percentage (different in the two gases and always a lower percentage with water gas than with coal gas), above which the danger increases, and below which it diminishes, very rapidly. This percentage is known as the "*danger-line*," or "*threshold*," and varies widely with individuals, sex, physical condition, etc. In terms of carbonic oxide it is probably never very far from 0.5 per cent. for the human species.

The reason why water gas is so much more dangerous than coal gas, appears to be that this danger line is comparatively easily reached or overstepped with water gas, rich as it is in carbonic oxide, while the comparative poverty of coal gas in this respect, brings it well below the line into the region of comparative safety.*

IV. *Our experiments confirm the work of Gruber and others who claim that carbonic oxide is not a cumulative poison. That is, the breathing of a small quantity for a long time is not equivalent to the breathing of a large quantity for a short time. A similar conclusion may be drawn for all the constituents of illuminating gas.*

This, however, does not preclude the possibility, which can hardly be doubted, that even small quantities produce their proper physiological effects though these may not be immediately perceptible.

From the fact that carbonic oxide is not a cumulative poison and from the considerations mentioned under paragraph III. concerning the rapid increase of danger above, and the decrease of it below the "danger line," it follows that, within certain limits, the less carbonic oxide there is in illuminating gas the safer it is for public use. For about the danger line a very moderate decrease of carbonic oxide may very greatly enhance its safety, while a moderate increase may very greatly multiply the dangers arising from its use. Nevertheless, with very high percentages of carbonic oxide and with very low ones this does not hold good, because far above and far below the danger line, the effect of slight variations is very little.

We may now illustrate the foregoing conclusions by examples drawn from our own experiments and more fully described in the appendix. And first, as to the difficulty of charging rooms heavily with illuminating gas. (Expt. III. App. C.)

* In these particulars carbonic oxide is not different from many other poisons. Thus a grain of morphia generally proves fatal to a healthy adult. A quarter of a grain is generally harmless. Obviously, the grain is not merely four times as dangerous. But between the quarter and the whole there must be some quantity which is a sort of limit of safety, and above which danger becomes imminent, while below it safety rapidly increases.

A room containing 1,140 cubic feet of space was supplied with four ordinary burners. Through these there entered the room at a tolerably constant rate during 24 hours, 1,200 feet of coal gas. Yet at the end of the 24 hours the top of the room just above the burners contained a mixture of gas and air of which the former composed only 3 per cent., while the lower portions of the room showed less than 1 per cent. Again, a room holding about the same amount of air received 55 feet of water gas during 1½ hours. At the end of that time the largest amount discoverable in the room was 1.1 per cent. of gas in the whole mixture of gas and air.

To illustrate the second conclusion, viz., that it is somewhat difficult to get in enough gas by the ordinary fixtures to kill, if the gas be coal gas, but relatively easy if it be water gas, it is only necessary to note the effects of the two experiments just quoted. In the former (coal gas) after 24 hours the animals though somewhat drowsy and stupefied were not seriously affected, while in the latter, after 1½ hours only, similar animals showed most alarming symptoms and one was dead from the effects of the gas. From other experiments it is certain, that had this experiment been long continued, others, and probably all the animals would soon have perished.

Similar considerations illustrate the third conclusion, for it is impossible to say that in the latter case the animals were only four or five times worse off than in the former. It is plain that as their lives were in imminent danger and as they were vomiting and in distress, it is not possible to express their relative danger mathematically. The first experiment (III. App.) just mentioned also indicates that carbonic oxide is not cumulative, for exposure to a small amount for 24 hours led to no serious consequences.

As to the time required to produce poisoning: this seems to be merely the time required to attain a poisonous percentage of carbonic oxide; and this clearly depends on the rate of inflow, the size of the room, the leakage, etc. Nevertheless, owing to the peculiar fact already mentioned that the danger line for both kinds of gas probably lies between 0.2 of one per cent. and 8 per cent. of gas in a mixture with air, (though always lower with water gas than with coal

gas), and that with ordinary rooms and ordinary fixtures such percentages are liable to be obtained, it becomes interesting to compare the time relations in such apartments.

The following experiments (App. C, IX, X) illustrate this, besides showing how, under certain circumstances, a very moderate inflow of the two gases may lead respectively, to totally different consequences:

By means of partitions, two rooms — one in Newton and one in Athol — were made as much alike as possible, both as to shape and cubic space. Each room had a capacity of about 700 cubic feet, which was somewhat larger than a room in Middletown in which a fatal case of poisoning from water gas actually occurred. Three dogs, two cats and two rabbits, were placed in the room in Athol, and the water gas in use there, containing about thirty per cent. of carbonic oxide, was allowed to flow in from a single ordinary burner, at the rate of six feet per hour. The experiment began at 11.15 A.M., and at 12.45 P.M. vomiting, delirium, convulsions, etc., had already been noted. Half an hour later, all the animals were unconscious, or apparently so, failing to respond to calls and to vigorous knocks upon the walls. At 2.30 P.M., or about three hours from the start, the two cats were dead, and the other animals were prone and quite unconscious. The dogs died at 3, 4, and 6.30 o'clock, respectively, — the rabbits, also, at 6.30. In a word, symptoms of poisoning were well developed in an hour and a half. Deaths began to occur in a little more than three hours, and all were dead within eight hours.

In the corresponding experiment at Newton, made with coal gas containing about seven per cent. of carbonic oxide, two dogs, two cats, two rabbits and two pigeons were placed in the room, and the gas was introduced from an ordinary burner, as before, and at the same rate, — six feet per hour. The experiment began at 8 A. M., and for three and one-half hours no symptoms of consequence were observed, and then only drowsiness and general anxiety, with salivation in one case. At 4 P. M., *i. e.*, after eight hours, at the end of which time in the other experiment all the animals were dead, nothing more than a gradual exaggeration of the symptoms had occurred. Recovery, apparently, would have been still possible and even easy, at this time.

After twenty-four hours, *i. e.*, at 8 A. M. of the next day, one cat and one rabbit were dead, but the others though stupefied were not unconscious, being still responsive to knocks and calls. There is little doubt, moreover, that as the night was extremely cold (below 0° F.) and the rabbit was young it was somewhat chilled by the cold and thus succumbed the more readily to the gas.

In view of the foregoing conclusions based upon experimental evidence herewith presented, it seems to us that it must be admitted by all that water gas with its 30 per cent., more or less, of carbonic oxide is a more dangerous substance than coal gas with its 6 per cent. or 7 per cent. of carbonic oxide, and that the only question that can be raised is, How much practical importance is to be attached to this more poisonous character. It will help to answer this question if we consider under what circumstances accidents are likely to occur as a result of the general distribution of gas for illuminating purposes.

There are five principal ways in which such injuries are likely to arise, as follows: —

1. By suffocation: as when workmen are overpowered in the trenches by large quantities of gas escaping from broken or leaky mains.

2. By the formation of explosive mixtures with air, owing to the escape of the gas in any manner.

3. By poisoning during sleep, from the escape into the sleeping-room of gas from the burner because, owing to defective fixtures, to accident, intention or ignorance, the light has been put out while the gas is still allowed to flow in.

4. By the slow and obscure poisoning (especially of feeble or anæmic persons) owing to leaks in or about pipes or burners in ordinary dwelling-rooms.

5. By poisoning, especially at night, when doors and windows are generally closed, with gas escaping from broken (street) mains into the earth, afterwards passing through drains or through the soil to the basements of dwellings, and thence upwards throughout the house.

With regard to the first source of danger (suffocation) there would be practically little difference between coal and

water gas, if the escape were very great. Yet as we were told repeatedly by the workmen in Middletown that accidents to their class have increased very greatly since the introduction of water gas there, making it more common than formerly for them to be "knocked over," as they express it, by the gas, there is possibly something to be said in favor of coal gas, even in this particular. Cases of this sort seldom result in death, as help is generally near and experience has made the workmen watchful of themselves and of one another.

In respect to the second source of injury (explosive mixtures) there is probably no great difference between the two, as the limits within which an explosive mixture may be formed are so wide apart, that the differences in the composition of the gases would probably make no difference in practical effect.

In the third case (poisoning during sleep by escaping gas) water gas would be undoubtedly more likely to produce injurious and even fatal results. As has been already stated it is not an easy matter for enough coal gas to escape into an ordinary room to produce serious consequences. Even when no provision is made for ventilation there is a considerable circulation of air through cracks and crevices and even through the apparently solid walls and ceilings. It is owing to this fact that accidents from poisoning, and from explosions of coal gas are not more frequent than they are. We have already referred to this fact of leakage, but in order to insist upon its importance in the choice between two illuminating gases we may record here an experiment bearing directly upon this point.

In the house occupied by one of us, the servant's room measures $8 \times 14 \times 10.5$ feet and contains consequently about 1,200 cubic feet of air. The room has two windows and two doors, and is ventilated by an iron stove-pipe 4 inches in diameter, which enters a chimney-flue 6 feet distant. On the day of the experiment, the flue was cold. The gas in the room was lighted and turned on so as to give as large a flame as would ordinarily be used. It was then blown out and the gas allowed to escape at the rate of between five and six cubic feet per hour, for eight hours and a half. At the end of four hours the room was entered and a sample of air

taken: also at the end of eight and a half hours several samples were taken at the level at which the head of a person lying in bed would be. The air was found to contain less than half of one per cent. of gas or not more than 0.03 of carbonic oxide. If the burner had been opened as wide as possible, it is not unlikely that the air might have been brought to contain one per cent. of gas. This would be only about 0.06 per cent. of carbonic oxide.

The chamber may be considered as a fairly well ventilated room, and it is evidently on account of the difficulty of introducing a poisonous amount of gas from a common burner into a room only fairly well ventilated, that serious or even fatal accidents from the inhalation of coal gas are not more common. With water gas the chances of injury would be very much increased, although in this particular room a fatal case of poisoning would not be likely to occur. One per cent. of the gas would mean 0.30 per cent. of carbonic oxide, an amount which would probably not be fatal but which would be certainly injurious, especially if breathed during the whole night. Nevertheless, in spite of the difficulty of reaching the poisonous limit with coal gas we know that fatal accidents from its use do from time to time occur. It is easy to understand this if it is remembered that in special cases, as when the room is very small or very "close," or when the inflow is unusually great, a dangerous percentage of coal gas may be reached. Moreover, the susceptibility of individuals varies widely and it is well known that the vital resistance at times falls very low, from disease, from intemperance, from exposure, or from poor nutrition. It is probably due, in part at least, to facts like these, that deaths from gas are more common in the poorer parts of cities, in the poorer hotels, etc. These cases would not be less fatal nor less common, but rather more common and more often fatal with water gas.

We know further that not unfrequently the smell of gas attracts attention to a room in which it is escaping and that a slumberer is awakened and "brought to" often with difficulty and with temporary ill effects following. In such cases the chances of serious injury would be greater if water gas were employed and the fatal results would be more frequent.

The water gas would be no more liable to escape than coal gas, but if it did escape the chances of injurious effect would not be simply four or five times as great, because there is four or five times as much carbonic oxide, but this greater amount of carbonic oxide might make all the difference between comparative safety and certain danger, or even between life and death.

The same general statement may be made about the fourth source of injury (slow and obscure poisoning by leaks in the fittings) as about the third. While a sound and healthy person, taking abundant exercise and enough of good food, may endure, and not suffer perceptibly from, a very small quantity of illuminating gas diffused through the atmosphere of a room and hardly discoverable by its odor, the cases cannot be neglected of those, especially women, whose vital resistance is at an ebb from ill health, lack of exercise, anæmia, intemperance, poor nutrition, or who are closely confined in small and poorly ventilated rooms. Under such conditions, thousands of persons live, and that leaks are very common in houses is known to any one who will take the trouble to read a number of meters during the daytime. Indeed, it is often the case that visitors detect the odor of gas in rooms where it has been unnoticed by the inhabitants. In cases of this kind there can be no question that the use of water gas would not diminish but rather would considerably aggravate the evil. A case of injury from this source in a house which was not small nor poorly ventilated has come to the personal knowledge of one of us.

A lady in fair health began, somewhat suddenly, to suffer from intolerable headaches. These were worst on awakening from sleep, and wore off generally during the day, to return the following morning. A physician vainly endeavored to control them, and finally observed, or was told of, a faint odor of gas in the sleeping-room. A search resulted in the discovery of a leak in a pipe running under the floor; and after the leak was stopped the lady quickly recovered. The gas in this case was water gas, and it is safe to say that if it had been coal gas it would have proved less harmful and might possibly have done no injury at all.

A similar view may be held regarding the fifth source ot

injury (escape from broken mains into the earth and thence into houses) as has been taken of the third and fourth.

A number of fatal accidents is on record from this cause which is particularly active in winter when the ground is frozen and perhaps covered with a coating of ice. Even if the ground is bare, the fact that the temperature of the houses is considerably above that of the outer air, converts them into so many chimneys, as it were, to which the air in the ground is drawn from all sides. If a leak occurs, the gas may find it easier to traverse a considerable distance in a horizontal direction than to pass directly into the air above.

It happens, unfortunately, that nearly all the observations in this matter with which we are familiar, have been made in Germany,* but every winter our newspapers contain instances of the escape of gas from mains into cellars or basement (often, even, of houses not supplied with gas), with more or less serious results. It is true that the statement is almost always made, that the gas found its way through an unused or forgotten drain; but, at least in some instances, this explanation is probably adopted simply because the passage of air and gas through the soil is a matter which is unfamiliar to many people. Professor W. O. Atwater, of Wesleyan University, has informed us of a case in Middletown, Conn., in which "the occupants of a house into which no gas pipes extend, had been troubled by a smell of gas which first appeared in the cellar and afterwards pervaded the house, notwithstanding the outside cellar door had been left open. Plants in the house wilted and dropped their leaves, and the occupants complained of unusual headaches." Professor Atwater further describes it as "a case of evident entrance of gas into the cellar from a leak in the main. For the street lamp close by had burned dimly, or not at all, for some time, and passers by had noticed a very decided and to some, offensive odor of the gas."

Fortunately in this case no fatality occurred, though several cases are on record in which lives have been lost in this way. Here, again, it is plain that water gas would not be less, but probably more, injurious than coal gas.

*Pettenkofer: Beziehungen der Luft zu Kleidung, Wohnung und Boden, Braunschweig, 1877.

The question has been raised, whether the gas in passing for some distance through the ground might not lose its odor and thus escape into houses or other buildings without being perceived. Every one knows, that the ground in the vicinity of leaky gas pipes becomes impregnated with the characteristic odor; we should therefore infer that the gas must lose some of its odorous ingredients. It may, however, be the case, that the amount lost by any given volume of the gas is *proportionally* too small to make a noticeable difference in the gas itself, although the continued passage of the gas makes the soil decidedly odorous. The experience of those connected with gas distribution has shown that leaks may occur in the mains without the facts being discovered by the odor of escaping gas, and, in fact, it was determined by the experts of the Berlin gas works some years since, that a leak of not more than 0.2 cubic meter in twenty-four hours, would not attract observation. It seems to be generally agreed, that there is a peculiar and characteristic odor which may be removed if the gas passes for a sufficient distance through the ground, but the gas does not, as a rule, become perfectly odorless, and probably persons, who were not experts would pronounce the odor that of gas.

The gas which escapes through the ground is also noticed to be less luminous than before. This may be due in part to its being mixed with air, for it is possible to diminish the illuminating power very considerably, by an admixture of air (especially ground air with its higher proportion of carbonic acid), without producing an explosive mixture. The generally received idea is that, in passing through the ground the gas loses a greater or less portion of the heavy hydrocarbons — the illuminants — along with the peculiar odorous substance or substances, the exact nature of which is not known.*

The only experiments with which we are acquainted, where analyses were made of the gas before and after passing through the soil, are those of Biefel and Poleck,† who

* Poleck (Journ. f. Gasbeleuchtung, XIX (1876), p. 12) considers phenyl mustard oil (C_6H_5CNS) as typical of the odorous substances characteristic of illuminating gas. It is probable that they are compounds containing sulphur and nitrogen but they have not yet been isolated. The absolute amount present in any case is very small.

† Zeitschrift für Biologie, XVI (1880), p. 313, also Dingl. polyt. Journ., CCXL, p. 199.

passed gas slowly through a pipe 2.35 meters (say seven and one-half feet) long, and five centimeters (say two inches) in diameter, filled with sandy loam. The pipe was connected with the gas main between the purifiers and the gas holder. The analysis of the gas before and after its passage through the soil gave the following results : —

	Before.	After.
Carbonic acid, . . .	3.06	2.23
Oxygen, ...	0.00	6.55
Illuminants, ...	4.66	0.69
Carbonic oxide, . . .	10.52	13.93
Marsh gas, ...	31.24	17.76
Hydrogen, ...	49.44	47.13
Nitrogen, ...	1.08	11.71
	100.00	100.00

These analyses are not altogether satisfactory, and it would appear that the air originally in the pipe had not been entirely displaced when the issuing gas was taken for analysis.

We have made some experiments in the same direction. A galvanized iron cylinder, ten feet long and eight inches in diameter, was filled with the material under examination; the gas was passed slowly in at one end through a quarter-inch tube, and issued at the other end through a similar tube. If gas be introduced into such a pipe it does not force the air out bodily before it, but mixes with it more or less, at first, and we think that in some experiments which have been made with reference to this matter, the diminished odor and illuminating power of the gas may have been partly due to the fact that it contained air mixed with it. In our experiments the gas entered at the top of the cylinder which was placed vertically in order to take advantage of the lower specific gravity of the gas and avoid mixing as much as possible; the gas was allowed to flow slowly (one cubic foot in from twenty-five minutes to two hours), and samples of the air or gas which escaped from the bottom of the cylinder were taken at intervals. If, after the air was entirely displaced, the issuing gas was not different in composition from that which entered, an end was put to the experiment; if there was a marked difference, the gas was allowed to flow for a longer period. For two materials which might be regarded as most likely and least likely to absorb the heavy hydrocarbons, we employed fine, pure, silicious sand (kindly

furnished by the Berkshire Glass Sand Company, Cheshire, Mass.), and ordinary coal ashes, such as are frequently used in filling low land. We also employed a mixture of dry clay with three times its bulk of sand.

The details of the experiments will be given in the appendix; the general results may be briefly expressed as follows: The capacity of the cylinder was approximately three and one-half cubic feet, about two-thirds of which would be occupied by the substance of the filling material, and one-third, say one and one-sixth cubic foot, would at the beginning of the experiment be filled with air. When gas was introduced, at the rate of one cubic foot in from twenty-five minutes to two hours, the issuing mixture would begin to burn as soon as from 1.2 to 2 cubic feet had entered the apparatus; the air was not, however, displaced completely until about four cubic feet of gas had flowed in. What escaped thereafter was either gas, or gas robbed of some portion of its constituents. With clean silicious sand, or with a mixture of sand and dry clay, the gas did not seem to be affected to any appreciable extent. When, however, the cylinder was filled with coal ashes such as are used in "making" land, the results were very different. The passage through only ten feet of this material at the rate of one cubic foot in fifty minutes, the temperature being about 70° Fahr., was sufficient to cause an almost complete removal of the heavy hydrocarbons, and with them of a great deal of the odor and of the illuminating power. It is thus evident that coal gas (and the case would be the same with water gas) in passing through the ground may lose its odor to a great extent, and it would appear that land made by filling in with ashes (where, owing to settlement, leaks would be likely to occur,) would be particularly liable to unnoticed escape of gas.

We had hoped to try other descriptions of soil but have not yet had the opportunity of doing so.

We have not thought it necessary to discuss whether water gas has proved, in actual practice, to be more injurious than coal gas, since that phase of the subject has been carefully studied by the Health Officer of your Board; neither have we thought it necessary to enter into the details of the opinions of others on the relative poisonous qualities of the

two sorts of gas.* We are aware that the matter has been discussed before this time both at home and abroad. Our object has been to draw independent conclusions from our own experiments. We cannot, however, forbear to make one quotation.

Twenty years or more ago wood gas was somewhat largely used in Germany, but its use has been in great measure abandoned, owing to technical difficulties attending its production. In 1869, a writer on water gas had expressed the opinion that the prohibition of this gas on account of its poisonous character was absurd, and that air containing a considerable proportion of carbonic oxide might be breathed with impunity or at the cost of a slight headache. Wagner in his *Jahresbericht* (1869, page 735) says, "Most readers of the *Jahresbericht* will hardly agree with Mr. C. Schinz on this point. How many fatal cases of carbonic oxide poisoning have been caused already by the escape of unburned wood gas with its from 20 to 30 per cent. of carbonic oxide!"

This expression of Wagner, who was at the time one of the first technical chemists in Germany, and who, owing to his position as editor of the Annual Record of Chemical Technology had peculiar facilities for knowing whereof he spoke, must carry with it the greatest weight.

In conclusion we desire to express our thanks to the authorities of Wesleyan University, and especially to Professor W. O. Atwater for permission to carry on experiments upon the University premises, and for much personal assistance; to Medical Examiner Dr. J. P. Lynde of Athol, Mass., for aid of the same kind; to Dr. S. W. Abbott the Health Officer of your Board for counsel and assistance; and to Miss A. M. Stantial for assistance in making analyses.

It will be understood that while the authors of this paper are jointly responsible for all statements of facts or opinion, the physiological portion has been mainly in the hands of Professor Sedgwick, and the chemical portion mainly in the hands of Professor Nichols.

* See, in this connection, the excellent reports of C. W. Hinman, State Inspector of Gas and Gas Meters for Massachusetts, who has published a bibliography of this subject to which he has himself contributed a number of interesting experiments. — *House Document*, No. 50, 1885.

APPENDIX.

A. Methods of Analysis.

In the analysis of samples of illuminating gas, Hempel's (unjacketed) apparatus was employed and the results are stated in the terms usually employed by gas analysts. In examining air containing only a small proportion of gas, a different method was necessary. To determine with absolute accuracy the amount of coal gas or of water gas present in the air of a room, is from the nature of things an impossibility. To be sure, we speak of the gases as though each were a single substance, but, as already stated, we have in reality in each case a mixture of a number of different gases; of different specific gravities. Thus, we have hydrogen, with a specific gravity of 0.069, marsh gas, with a specific gravity of 0.557, carbonic oxide, with a specific gravity of 0.968, ethylene, with a specific gravity of 0.978, besides other gases. When a limited volume of illuminating gas is introduced into a room, it does not mix with the air of the room, preserving at the same time its own identity, but each of the constituent gases mixes on its own account, the lighter gas mixing much more rapidly than the heavier, so that, unless the room were *absolutely* tight, and a considerable time were allowed for the mixing to take place, samples of air from different parts of the room would contain the constituents of the gas in different proportions.

After a time, provided the conditions of artificial and natural ventilation are constant, a condition of equilibrium is reached, easily destroyed by changes in the force or direction of the wind, in the temperature and in the barometric pressure. While for this reason, and on account of the possible slight changes in the quantitative composition of the gas during an experiment, absolute accuracy cannot be expected, results sufficiently accurate for our present purpose can be obtained. As the constituents of the gas are either hydrogen (or compounds thereof) or compounds of carbon, the nearest approach to a statement of the "amount of illuminating gas" would be obtained by determining the amount of hydrogen (free or combined) in a certain volume of the air, and the amount of carbon (combined) in the same volume of air, by reckoning from these data the corresponding volumes of gas, and by taking the mean of these two results.

This is what we have done. A known mixture of air and coal gas was made, containing from two to four per cent. of the gas. This mixture, after drying and removal of the carbonic acid, was passed through a heated combustion tube, charged with oxide of copper, and the water and carbonic acid produced by the combus-

tion of the gas were weighed. From these weights were calculated the amounts of hydrogen and carbon obtained from a given percentage of the gas. A measured volume of the air under examination was then passed through the tube (being displaced by mercury from the vessel in which it was collected) and the corresponding amount of coal gas calculated both from the water and from the carbonic acid. The mean of these results was taken. When it was a question of water gas, a mixture of water gas and air containing a known percentage of the former was made and treated as described, in order to afford a basis for calculation. For the reasons stated and because the percentages of gas with which we had to deal were so small (the weight of carbonic acid or water formed by the combustion generally not exceeding twenty milligrams and being often much less than this) very great accuracy cannot be claimed for the results. Where from 1.5 to 3 per cent. of gas was present the results are probably within three or four tenths of a per cent. of the truth. Where less than one per cent. is present it would perhaps have been as well to content ourselves with stating "less than one per cent. present;" it has, however, been thought better to give the results actually obtained as being not far out of the way.

B. The Analysis of various Samples of Gas.

The Boston gas used in the experiments is subject to considerable variation in composition, and that which is drawn in the laboratory of the Institute of Technology is probably somewhat different from that delivered at other parts of the city at the same time. It is a coal gas enriched with naphtha. In the following table we give the results of an analysis reported last year by the State Inspector, and of several which we have made during this investigation.

	Hinman	S. & N.			
		Dec. 30, 1884.	April 30, 1885.	May 24, 1885.	Sept., 1885.
Carbonic acid, . .	1.08	0.88	0.05	0.91	0.92
Oxygen, ...	0.00	0.50	0.00	0.20	0.13
Illuminants, . . .	5.21	4.09	4.29	4.42	5.48
Carbonic oxide, . .	6.74	5.76	7.15	6.55	6.57
Marsh gas, . . .	38.67	–	–	36.91	–
Hydrogen, . . .	47.49	–	–	48.96	–
Nitrogen, . . .	0.85	–	–	2.11	–

The Newton gas is similar to the Boston gas. At the time of our experiments the carbonic oxide amounted to 7.67 volumes in 100.

The water gas from Middletown and that from Athol had the following composition; no doubt there is as great variation from time to time as with coal gas: —

	Middletown, Conn.		Athol, Mass.	
	Dec., 1884.	Jan., 1885.	Jan. 13, 1885.	Feb. 18, 1885.
Carbonic acid, . .	3.42	2.49	0.77	0.67
Oxygen, ...	0.88	0.87	1.47	0.21
Illuminants, . . .	10.78	10.65	10.67	10.32
Carbonic oxide, . .	30.33	30.79	29.07	29.37
Marsh gas, . . .	–	19.10	22.09	–
Hydrogen, . . .	–	30.14	26.75	–
Nitrogen, . . .	–	5.96	9.18	–
	–	100.00	100.00	–

C. *The Experiments with Animals.*

The original room constructed to meet our requirements (Room A, see beyond), was finally used only for coal-gas experiments, on account of the difficulty experienced in getting supplies of water gas in the same town. All the work upon coal gas was done in the original room in Newton Centre, while the work upon water gas was done in other rooms, — some of it in Middletown, Conn., and some in Athol, Mass. But in all cases, whether of coal or water gas, the supply for the experiments was taken from pipes of the local company, and allowed to escape into the apartments through ordinary burners supplied by the local gas-fitters, and connected with meters for the registration of the inflow.

Samples of the inflowing gas were taken by displacement, and afterwards analyzed (see above, B).

Different animals, usually of several species, were placed in the room before the experiment began, and their symptoms carefully noted as the experiment went on. Samples of the atmosphere which they breathed were taken from time to time by entering the room and emptying into a vessel, demijohns (generally holding one gallon) previously filled with water. These were carefully stop-

pered with solid corks, then taken from the room and immediately sealed with melted paraffin. These samples were afterwards analyzed (see methods of analysis above, A). The time of the sampling was also noted. With regard to the room, it should be repeated that it was our endeavor to imitate in a general way sleeping-rooms of medium size as they actually exist. In no case were windows made to fit more tightly than usual; the "crack" above the threshold was always left open; while, on the other hand, no unusual holes or other escapes were allowed to remain; so that in this respect, also, we reproduced as far as possible the conditions of an ordinary sleeping-room whose doors and windows are left closed. The rooms, in fact, gave the impression of "close," but not unusually tight, apartments.

The original room (Room A) was built in a barn in Newton Centre, and made tight by partitions of matched boards. The ceiling was matched and double, with an intervening air space. The walls were single on two sides and double on two, and of three-fourths inch boards, matched. The floor was double and tight. Overhead was an empty loft; underneath was a cemented cellar; and the room, being partitioned off in a corner of the barn, was separated from the barn proper by the single partitions, — from the outside by the single partition, the air space and the ordinary wall of the barn. There was one window (about five feet by three) admitting light from without, and two long but narrow windows were built into the partitions for convenience of observation. They fitted into casings in the usual way. One door of the ordinary size served for entrance, and, when closed, fitted somewhat loosely, leaving a narrow crack beneath. The dimensions of the room were as follows: —

Room A. Newton Centre.

Length, . . .	13 feet 4 inches,	Capacity, 1,140 feet.
Height, ...	9 feet,	
Breadth, . . .	9 feet 6 inches,	

It contained two shelves and one two-story pine table. The gas-fixture was a cheap, plain, four-arm chandelier hanging from the middle of the ceiling. A meter was connected, and located for convenience in the barn, where the observer could easily read it at any time.

Experiment No. I. — *Newton Coal Gas.*

[Sept. 16, 1884.]

Four rabbits and four pigeons were put in the room, enclosed in cages having coarse wire-gauze tops and sides.

They were put — the rabbits, (A) on a shelf just below the level of the burners, but on the side of the room; (B) on a shelf eighteen inches

lower and on another side of the room, somewhat nearer the gas-fixture; (C) on the floor by the window; (D) on the floor near the door. The pigeons (A) by rabbit A; (B) on the table under the fixture; (C) by rabbit C; (D) on the floor in the middle of the room. The animals were all apparently healthy and in good spirits.

One jet was opened full at 10.35 A.M. The meter recorded an inflow of 14 feet per hour. At 11.35, or after one hour, no effect upon the animals was perceptible. At 12.05, or after an hour and a half, as no effect whatever could be perceived, a second and a third jet were opened full. The rate of inflow now rose to 32 feet per hour; but save for various signs of drowsiness, *e. g.*, stretching, and in the case of rabbit B a laying back of the ears and evidence of slight discomfort, there were no symptoms whatsoever of poisoning, nor even of serious discomfort.

At 1.35, or after three hours, the fourth and last jet was opened full, and the rate of inflow rose to 38 feet per hour — all the jets "blowing" hard. But at 3 o'clock the animals were not noticeably changed, and at four were apparently only somewhat more drowsy. The gas was shut off at 4.11 P.M., after 174 feet in all had flowed in. A sample of the mixed gas and air was taken, but showed so little gas that it was discarded.

The day was very windy, and the corner occupied by the experiment room was much exposed to wind from that particular direction, — south of west. This experiment, therefore, which was done in order to gain experience and to serve as a basis of operations, should not receive too much consideration.

EXPERIMENT NO. II. — *Newton Coal Gas.*

The animals the same and in the same places as in Experiment No. I.

Sept. 18, 1884. No wind. At 3.40 P.M. all four burners were opened full. Rate of inflow 36 feet per hour. At 5.40, or after two hours, all the animals were apparently as well as ever, and the gas was shut off. This experiment was confirmatory of No. I., and showed besides that the exemption from injury in that experiment was not due to the wind.

EXPERIMENT NO. III. — *Newton Coal Gas.*

This experiment was deferred till Nov. 17, 1884, and was undertaken in order to discover the effects of long exposure to the gas. The day was clear and cold and very still. The room (Room A, Newton Centre), had in the meantime been covered internally, except the floor, with cotton cloth, and upon this a plain paper hanging had been carefully pasted, so that the room was somewhat tighter than before.

Two rabbits, three pigeons and one dog were put into the room, and at 7 A.M., November 17, the four jets were opened full. The gas flowed in all day and all of the following night. At 12.30, noon, November 17, or after five and a half hours, a sample was taken (November 17, A), from the level of the table. At 5 P.M., or after ten hours, the animals were not visibly affected. At 7 A.M., November 18th (*i. e.*, after twenty-four hours' exposure, without food, and after 1,200 feet had run in, as was shown by the meter), one rabbit showed signs of discomfort,

and the dog seemed weak and unsteady in the hind legs. All, however, were easily roused by knocks upon the walls, by calls and whistling, and were by no means severely affected.

At 7 A.M., November 18, three samples of the atmosphere of the room were taken:

November 18, A — From a point one foot above the floor.

November 18, B — From the top of the table.

November 18, C — From a level about six inches above the burners but not over them.

The last sample was taken by standing on a box and reaching upwards nearly to the ceiling, and it was noticed that the atmosphere was very "thick" and seemingly almost suffocating. No bad effects were noticed, however, by the observer, after the taking of the samples. On analysis these gave the following percentages of gas.

November 18 — A, ...	0.9 %.
November 18 — B, ...	0.7 %.
November 18 — C, ...	3.0 %.

The sample taken the day before showed, November 17 — A, 0.5 %.

Efforts had already been made to get a sufficient supply of water gas for comparative experiments, but thus far without success. Further attempts were now made, but it speedily became clear that it would be easier, and in some respects better, to visit some town in which water gas was distributed, than to persist in the attempt. Accordingly, on Jan. 2, 1885, a preliminary experiment was made in a room in the Chemical Laboratory of the Judd Building of Wesleyan University, Middletown, Conn., kindly placed at our service by Prof. W. O. Atwater. The room contained a little less than 2,000 feet, free space, and was furnished with one very large window and two doors. It was plastered, but not free from cracks. Dimensions, $11 \times 12\frac{1}{3} \times 15$.

EXPERIMENT No. IV. — *Middletown, Conn., Water Gas.*

Two rabbits, two pigeons and one small dog were placed in different parts of the room, to which gas was admitted by an ordinary pipe terminating in six jets. The jets were somewhat to one side of the middle of the room and about six feet from the floor. To two of these rubber tubes were attached, and the gas was emptied from these a little below the middle of the room and downwards. The others faced upwards as usual.

At 10.53 A.M., January 2, the jets were opened. Almost at once the dog, which had been barking noisily, became quiet. The gas flowed in at about 50 feet per hour. As our experience with coal gas had led us to expect no immediate result, we were astonished to find the animals prostrate and apparently insensible, not responding to knocks upon the window nor to calls, within an hour; viz., at 11.40. At 12.05, or after one hour and twelve minutes, the dog and the rabbit, most readily seen, lay insensible and unresponsive. At 12.50, or after two hours, the dog was taken out nearly dead. One pigeon was dead; the other nearly so.

One rabbit was almost dead, while the other was not much affected. The second pigeon soon died, as did the rabbit most affected. But the other rabbit recovered, and the dog lived on a day or two in considerable pain till he was killed to end his suffering. The gas was turned off at 2.23. The meter showed that 185 feet had run in during the three and a half hours. The rate, therefore, was very nearly 52 feet per hour. Samples were taken, as follows: —

January 2, A — Near the dog, at 12.50, one foot above floor.

January 2, B — From level of the observer's eyes, above the dog, at 12.50.

January 2, C — From a ladder 10 feet above floor, at 1.25 P.M.

January 2, D — From a ladder 10 feet above floor, at 2 P.M.

These samples showed the following percentages of gas.

January 2 — A, ...	3.3 % by volume.
January 2 — B, ...	2.6 % " "
January 2 — C, ...	2.5 % " "
January 2 — D, ...	2.2 % " "

The celerity with which the animals succumbed in this experiment was a complete surprise after witnessing the feeble effects of Expts. I.–III. It is difficult to describe the impression which we experienced of the deadly character of the gas. Within an hour symptoms of the severest sort had developed; and while the atmosphere was less "thick" with gas and less suffocating to the senses than in Expt. III. the observer in the brief visits necessary to the taking of samples was partly overcome and suffered severely for some time after with trembling, loss of muscular control, slight nausea and an after headache of the severest character lasting for several hours. We went to Middletown impressed with the difficulty of killing animals with coal gas in fair-sized rooms, and anticipating a similar experience with water gas. But a single experiment showed conclusively that we were dealing with something physiologically very different. Analysis of a sample of the Middletown gas shows wherein it differs chemically (see above, B).

As the room used in Expt. IV. was needed for other purposes, the authorities of the university cheerfully granted the use of a smaller room, and one more suitable for our wants, in the old laboratory of the university. To this gas was conveyed and a ready-made room was turned into an experimental chamber. The dimensions of the room were as follows: —

Room C. Middletown, Ct.

Height, . .	7 feet 8 inches,	Capacity, 1,336 feet (when empty).
Length, . .	14 feet 4 inches,	
Width, . .	12 feet 2 inches,	

From this however must be deducted several heavy pieces of shelving, cases, etc., estimated roughly at 150–200 feet. It will be seen that the room, therefore, compares very well as to shape and contents with Room A, Newton. But it had plastered walls, two doors and two

windows, not in the best repair, and stood upon an exposed corner. On the whole, however, it was a tolerably close but not a tight room; less tight, if anything, than Room A.

EXPERIMENT NO. V. — *Middletown, Conn., Water Gas.*

[January 29, 1885. Cold (32°) but fine.]

Animals—1 dog, 1 cat, 1 rabbit, 1 pigeon.

The dog upon the floor, the rabbit in a cage 2 feet above the floor, the cat in a cage 4 feet above the floor, and the pigeon flying about at will.

Four jets opened at 4 P. M.

At 4.12. Already decided effects. Cat mewing and uneasy. Dog and rabbit licking their chops in a peculiar way often noticed in the experiments.

4.30. Dog lies down. Rabbit has a convulsive movement and squats. Cat mewing anxiously and unnaturally.

4.32. Cat lies down and refuses to rise as before at calls, but still perceives calls.

4.34. Pigeon, which had been perched on the top of an inside blind and for some minutes tottering, lost his balance and tumbled to the floor in a semi-helpless state.

4.35 (or after about half an hour). Dog struggles to his feet, and makes an apparent attempt to move, but falls in a strange way heavily upon his back with his feet uppermost, then slowly recovers himself and lies with his head upon his paws, naturally.

4.38. Dog rises, staggers and defæcates. Stands half supported and trembling. Cat grows more quiet; lies, however, prone and breathing heavily. Both animals still licking their chops.

4.39. Dog falls helplessly.

4.40. Dog vomits, lying on his side and apparently unable to lift his head. Cat apparently nearly dead, but now and then lifts a paw and clutches convulsively at the cage. Pigeon steps tremblingly about upon the floor.

5.07. Rabbit seems least affected and, if possible, even better than shortly before.

5.30. Darkness coming on, the gas was shut off, after sampling of the atmosphere of the room. The meter showed that 55 feet of gas had been let in and the rate of inflow was therefore about 37 feet per hour.

At 5.45. The cat was found to be dead, but the dog was reviving, and the rabbit, which had not suffered greatly, was in good order. The pigeon could not be found in the darkness, but the next morning was found apparently recovered, as were also the dog and the rabbit.

The samples taken gave the following amounts of gas in the mixture with air.

January 29 — A, 1.1 per cent. (5.30 P.M., taken 1 foot above dog prostrate on floor.)

January 29 — B, 0.5 per cent. (From level of cat-cage, 4 feet above floor.)

January 29 — C, 1.1 per cent. (From corner of room, near door, 6 feet from floor.)

Having now satisfied ourselves with this class of experiments, it was decided to try the effects of the escape of gas from *a single burner* for a long time. The first experiment, VI., Jan. 30, 1885, proved valuable but imperfect, as the burner from which the gas flowed became seriously clogged before the experiment was over. The violent effects obtained in spite of this partial stoppage of the inflow—probably before it actually occurred—are, nevertheless, instructive.

EXPERIMENT No. VI. — *Middletown, Water Gas.*

[One-burner experiment, Jan. 30, 1885.]

Animals — 1 dog, 1 cat, 2 rabbits, 1 pigeon.

One rabbit and the pigeon were the same as used the day before.

The dog was on the floor, the cat 4 feet above, the pigeon flying about, the rabbits, A about 1 foot from the floor, the other B near the ceiling. An ordinary swing burner, giving an ordinary light, was blown out at 9.15 A. M. Inflow, 8 feet per hour.

9.30. Animals mouthing and licking their chops.

10.45 (after 1½ hours). Pigeon and rabbit B (near ceiling) show some effects.

11.15 (after 2 hours). Pigeon uneasy and trembling. Cat anxious. Dog scarcely affected.

12 M. Decided effects in all cases.

12.15 (after 3 hours). Dog walks tremblingly. Knocks and calls provoke attention, but no movement. All appear dull, stupid and heavy.

12.30. Cat mewed wildly, worked jaws convulsively, opened mouth wide, repeatedly, with head drooping. Pigeon nearly lost his balance.

12.32. Cat vomited violently; made afterwards vain attempt to hold head up.

12.35 (after 3¼ hours). None react to hard knocks and calls or whistles.

12.37. Dog rises uneasily, staggers as he walks about, refuses to respond to calls, and after hard retching vomits profusely.

12.40. Sample of gas taken (Jan. 30, A).

1 P. M. Dog vomits again.

At 2 P. M. the meter showed that the regular rate had thus far been maintained; but henceforward, beyond some exaggeration of the symptoms, no great change occurred, and the reading of the meter proved that the flow had ceased about that time. An examination showed the fixture (a second-hand one) to be nearly closed with a viscous tar. The experiment is therefore untrustworthy after 2 P. M., and further details are omitted. In spite of this, it is noteworthy that within three and one-half hours violent symptoms of poisoning had appeared.

The sample taken at this time showed, January 30 — A, 0.7 per cent of gas.

EXPERIMENT NO. VII. — *Middletown, Water Gas.*

[One burner, Feb. 2, 1885. Cold, but fine.]

Animals — 2 cats, 2 rabbits, 2 guinea pigs, 2 pigeons.

Cat A, 4 feet from floor.	Position in the room.
Cat B, 2 feet from floor.	
Rabbit A, 6 feet from floor.	
Rabbit B, 2 feet from floor.	
Guinea pig, large, 2 feet from floor.	
Guinea pig, small, 2 feet from floor.	

Two pigeons flying about the room.

These animals were all fresh; but, besides these, one dog left from last experiment, and a pigeon previously exposed, were put in the room. They were not in very good condition.

At 9 A. M. one large jet was blown out and the meter noted. From the outset to the end of the experiment the uniform rate of 15 feet per hour was maintained, until the supply was cut off at 5 P. M.

10 A. M. Only general preliminary signs. All the animals uneasy and licking their chops.

10.35 (after $1\frac{1}{2}$ hours). Cat A vomits. Rabbit A very uncomfortable and squatting. Rabbit B unsteady. Cats both mewing in a terrified way.

10.45. Sample (Feb. 2, A) taken on level of cat A.

10.50. Cat B vomits.

10.55. Pigeon A very unsteady. Cat A lies down and fails to respond to knocks and calls.

[Wind rises and becomes strong.]

11.05 (after 2 hours). Pigeon A loses balance and falls, fluttering helplessly, to the floor.

11.15 (after $2\frac{1}{4}$ hours). Cat A prone and unresponsive. Cat B rises, mews deliriously, and walks about trembling and staggering. Rabbit B continually trying to escape, and as often falling over backwards after having risen up on hind feet. Guinea pigs mouthing and greatly agitated.

11.25. All the animals unresponsive.

11.30 (after $2\frac{1}{2}$ hours). Cat A vainly attempts to rise and falls in a heap, heels highest.

11.32. Cat B claws convulsively; head droops.

11.40. The pigeon left from the last experiment tumbles to the floor.

12 M. Pigeon B fell to floor.

12.15. Sample (Feb. 2, B) taken as before near cat A, 3 feet from floor. Respirations of cat B stormy. Air smells very thick, and produced sense of oppression and slight headache in the observer, who stayed only long enough to fill the demijohn.

12.45. No great change.

1.45 P. M. (after $4\frac{3}{4}$ hours.) Cat A dead; taken out nearly cold. Guinea pigs prone and twitching. Rabbit A very badly off.

2.15. Sample taken (Feb. 2, C).

2.30. Larger guinea pig dead and taken out.

3.30 (after $5\frac{1}{2}$ hours). Smaller guinea pig and rabbit B taken out dead. Cat B very shaky.

4.00. Sample (Feb. 2, D) taken. Cat B apparently nearly dead. Rabbit A trembling and very low.

5 P. M. (after 8 hours). Sample (Feb. 2, E) taken. Gas turned off — 120 feet having run in. Cat B dead. Pigeons badly off, but on floor and by no means dead.

Result: Still surviving — 2 pigeons, 1 rabbit. Dead — 2 cats, 2 guinea pigs, 1 rabbit, and 1 dog.

The samples showed the following amounts of gas.

Feb. 2 —	A,	0.5
	B,	0.4
	C,	0.8
	D,	0.9
	E,	0.4

Enough had now been obtained for a satisfactory comparison, but new interest was aroused by the inspection of a servant's sleeping-room in the house of one of the professors of Wesleyan University, in which a servant, Christine Wedel, had lost her life by the inhalation of illuminating (water) gas.* This room contained only about 600 cubic feet, and we therefore decided to make one or more comparative experiments in a smaller apartment than those we had hitherto employed. At this juncture a room was courteously placed at our disposal in Athol, Mass., by Medical Examiner Dr. J. P. Lynde. We accordingly repaired to Athol, and by means of a matched board partition, provided with a door and a window, secured a room somewhat larger in size and somewhat less tight, than that occupied at the time of her death by Christine Wedel. The latter was in fact unusually tight. It had but one window and one door, and these fitted well. This was not the case with Room D at Athol. For this possessed two large windows and one small one, and neither these, nor the door, were remarkably tight. Its dimensions were as follows: —

Room D, Athol, Mass.

Height,	8 feet 2 inches,	Clear capacity, 816 cubic feet.
Breadth,	10 feet 2 inches,	
Length,	9 feet 10 inches.	

From this, however, must be deducted about 100 feet occupied by a chimney, a bench, a large case, etc.

Experiment No. VIII. — *Water Gas, Athol, Mass.*

[One-burner experiment, Feb. 14, 1885.]

Animals used — 2 dogs, 2 cats.

One burner opened full at 11.30 A. M., 6 feet per hour.

At 11.35 one cat and one dog lick their chops.

* See the paper of Dr. Abbott in this volume, for full account of this case.

12.15. Cat A ($2\frac{1}{2}$ feet above floor) mewing anxiously; head drooping.

12.25. Dog A (on floor) rose, staggered and finally fell.

12.38 (after 1 hour). Cat A urinates and shows great salivation. Mouth wide open.

12.48. Dog B ($2\frac{1}{2}$ feet from floor) vomits.

12.50. Cat B (5 feet from floor) delirious.

12.55. Cat A wildly delirious.

1 P. M. Sample (Feb. 14, A) taken.

1 P. M. (after $1\frac{1}{2}$ hours). Cats vomit.

1.15 (after $1\frac{3}{4}$ hours). Dog A taken out dead.

2 P. M. Gas flowing in at a little less than 6 feet per hour.

2.45 (after $3\frac{1}{4}$ hours). Both cats dead.

3.45. Dog B nearly dead; insensible.

4.00. Still alive; near window.

5 P. M. Gas flowing in about 5 feet per hour. Dog B still living, but insensible.

5.30. Sample (Feb. 14, B) taken, and gas turned off. Dog B killed.

Meter recorded 35 feet during the six hours.

The samples showed: Feb. 14, A, 1.0 per cent.; B, 0.8 per cent. of gas.

As some desire was expressed by members of the State Board to witness an experiment, another was undertaken in Athol, in Room D, as follows: —

EXPERIMENT NO. IX. — *Water Gas, Athol, Mass.*

[One-burner experiment, Feb. 18, 1885. Room D. Cold.]

Animals used — 3 dogs, 2 cats, 2 rabbits.

Gas turned on full (one burner) at 11.15 A. M. Six feet per hour.

Symptoms.

11.55. Cat A ($3\frac{1}{2}$ feet from floor) rises and mews anxiously.

12.05. Rabbit A ($3\frac{1}{2}$ feet from floor) urinates.

12.10. Dog A (5 feet from floor) urinates. Cat A very uneasy, and at 12 15 urinates.

12.30. Dog B (on floor) vomits.

12.35. Cat B (3 feet from floor) delirious.

12.40. Cat A vomits.

12.42. Dog C (on floor) has a convulsion.

12.45. Sample (Feb. 18, A) taken.

1.15 (after two hours). All unresponsive to knocks and calls.

1.55. Cat A nearly dead; taken out to see effect, and revives; put back, and at 2.30 (after $3\frac{1}{4}$ hours) cat A dead. Cat B also dead.

3.00 (after $3\frac{3}{4}$ hours). Dog A dead.

4 P. M. Dog B nearly dead.

4.30 (after $5\frac{1}{4}$ hours). Dog B dead. Dog C nearly dead.

5.30. Dog C still alive. Rabbits very feeble. Sample (Feb. 18, C) taken.

7.00 P. M. (after $7\frac{3}{4}$ hours). All dead. Experiment closed.
Rate of inflow, 6 feet + per hour. Total inflow, 50 feet.
The samples showed: Feb. 18, A, 0.6; C, 1.0% of gas.

In order to compare these effects with those obtained in a room of the same size, into which coal gas should flow at the same rate, the room (Room A) in Newton Centre was rebuilt, and constitutes Room E.

Its dimensions were as follows: —

Height, . . .	9 feet,	Capacity, 726 feet.
Breadth, . . .	8 feet 6 inches,	
Length, . . .	9 feet 6 inches,	

It compared well in tightness with Room D.

EXPERIMENT No. X. — *Coal Gas, Newton Centre, Mass.*

[One-burner experiment, Feb. 20, 1885. Very cold.]

Animals used — 2 dogs, 2 cats, 2 rabbits, 2 pigeons.

Experiment began at 8 A. M. One burner (6 feet) opened.

9 A. M. No change, except quiet and licking of chops.

9.30. No further change.

10.00. Much licking of chops.

10.30. No further change.

10.45. Cat A (4 feet from floor) mews. Cat B (6 feet from floor) salivates and quickens respiration. Dog A (3 feet from floor) intently watching rabbit B, which is running about on the floor.

11.00 (after 3 hours). Animals all drowsy, except Cat A and the pigeons. Cat A uneasy and trying to escape. Dogs asleep. Rabbit A (3 feet from floor) slightly affected. Rabbit B very cheery and eating. Dog A awakes and licks himself elaborately. All respond to knocks and calls.

11.15 (after $3\frac{1}{4}$ hours). Cat B breathing very hard, and much affected. Cat A anxious. Rabbit A mouthing hard.

11.30. No further change.

12 M. Sample (Feb. 20, A) taken. Cat B salivating.

1 P. M. No further change.

1.30. All very drowsy. Pigeons both near the jet. One sits on arm of adjacent burner.

2 P. M. (after 6 hours). Cat B partly prone. Dog B very quiet Otherwise, animals merely drowsy.

2.30. Cat B salivating freely and trembling.

3 P. M. (after 7 hours). Cat B worse. Dog B semi-delirious, and like cat B.

3.15 P. M. Not very responsive. [The pressure had gradually increased, so that now 10 feet per hour were flowing in, and from 2.30 to 3.30 evidences of it appear in the symptoms. At 3.15, flow was reduced to 6 feet.]

3.30. Dog B and cat B very unresponsive. Rabbits comfortable.

Pigeons unaffected. Dog A drowsy, but readily responsive. Cat A mews, and very responsive.

4.00 (after 8 hours). No great change.

4.30. Sample (Feb. 20, B) taken.

4.40. Cat B very badly off. Dog B drowsy, but still recoverable. The rest unchanged. [The gas had flowed in at 6 feet per hour all day. The observer being obliged to go away at 4.40, the gas was left running all night.]

[February 21, 1885.]

6.30 A. M. (after $22\frac{1}{2}$ hours). Mercury 0° F. Gas still flowing in at 6 feet per hour. Knocked on wall. Dog A looked sleepily up. Cat A began mewing and seemed semi-unconscious, but rose and moved about. Rabbit A paid no attention, but sat as on the day before. Pigeons both sitting near the jet, and bright and observant; balanced themselves readily, though not very firmly, nor for very long, having frequently a tendency to topple off, which they nevertheless corrected. Cat B dead. Dog B very drowsy and difficult to arouse, but by persistent efforts finally responds to knocking on the wall. Rabbit B dead.

7 A. M. Dog very drowsy. Cat A mewing hard, but still able to stand. Dog A very drowsy. Rabbit A bright.

7.15. Sample (Feb. 20, C) taken. Meter shows inflow of 6 feet per hour for night. [Four jets were now opened, and the animals were unobserved till 4 P. M., owing to the enforced absence of the observer.]

4 P. M. Dogs both dead. Cat A very feeble. Rabbit A bright. Pigeons comfortable.

Meter records 260 feet for the past 9 hours; but now shows 50 feet per hour (4.30 P. M.).

6.30. Cat A dead. Rabbit A and pigeons alive. Gas shut off.

The next morning (February 22), the pigeons and rabbit A were still living and in fair condition.

The samples showed: February 20, A, 0.9 per cent.; B, 0.8 per cent.; C, 0.8 per cent. of gas.

CONDENSED TABLE SHOWING APPROXIMATELY

[For the complete record

Number of the Experiment.	Kind of Gas Used.	Greatest Inflow per Hour in Cubic Feet of Gas.	Estimated Capacity of the Room in Cubic Feet of Air.	Highest Percentage of Gas observed during the Experiment.	Number of Animals Exposed in the Experiment.	Effects Noted from		
						1 Hour.	2 Hours.	3 Hours.
I, .	Coal, .	38	1,140	–	8	None.	Drowsiness.	Discomfort.
II, .	Coal, .	36	1,140	–	8	None.	None.	–
III, .	Coal, .	50	1,140	3.0	6	None.	Drowsiness.	No further change.
IV, .	Water,	52	1,900	3.3	5	General insensibility.	Two dead.	Three now dead.
V, .	Water,	37	1,150	1.1	4	Severest symptoms. One dead.	– –	–
VI, .	Water,	8	1,150	0.7	5	Slight effects.	More marked.	Still more marked.
VII, .	Water,	15	1,150	0.9	8	Slight effects.	Muscular relaxation. Insensibility.	Insensibility. Convulsions.
VIII, .	Water,	6	725	1.0	4	Salivation. Urination.	Vomiting, etc. One dead.	Three now dead.
IX, .	Water,	6	725	1.0	7	Marked effects.	Insensibility, Vomiting.	Two dead.
X, .	Coal, .	6	725	0.9	8	No change.	No change.	Slight effects.

THE RESULTS OF THE EXPERIMENTS UPON ANIMALS.

SEE PRECEDING PAGES.]

Exposure of the Animals to the Mixed Gas and Air after—

4 Hours.	5 Hours.	6 Hours.	7 Hours.	8 Hours.	9 Hours.	24 Hours.
Slight effects.	-	-	-	-	-	-
-	-	-	-	-	-	-
No further change.	No further change.	-	-	-	-	Slight effects.
-	-	-	-	-	-	-
-	-	-	-	-	-	
Vomiting. Convulsions. insensibility.	-	-	-	-	-	-
Gradual increase in severity.	One dead. All badly off.	Three now dead.	Increased severity of symptoms.	Four now dead. Experiment closed.	-	-
-	-	-	-	-	-	-
Three dead.	Four dead.	Gradual decline.	Still more marked.	All dead.	-	-
Salivation and more marked effects.	No further change.	No further change.	Marked symptoms.	No further change.	Symptoms somewhat more marked	Two dead. The rest stupefied.

D.—Experiments in Passing Illuminating Gas through Various Materials.

Experiment No. 1.

The general nature of the experiments has been already described. In this experiment the material was clean, fine Berkshire sand, somewhat moist, containing in fact, 2.88 per cent. of moisture. The gas was passed into the top of the cylinder at the rate of one cubic foot in 25 minutes. The following analyses were made of the issuing gas: —

	Amount of Gas which had flowed in. Cubic feet.	Oxygen and Carbonic Acid. Per cent.	Illuminants. Per cent.	Carbonic Oxide. Per cent.
I, ...	2.1	15.5	–	–
II, ...	5.1	4.8	4.2	5.7
III, ...	7.8	6.8	3.2	6.5

It was then clear that the cylinder was not wholly tight and the experiment was interrupted; it was evident, however, that no considerable absorption of the heavy hydrocarbons or of the carbonic oxide had taken place.

Experiment No. 2.

The cylinder was resoldered and then three feet of gas were run through and a sample taken for analysis (I.). After 48 hours three feet more of gas were passed through the apparatus and another sample taken (II.). The results of the analysis were as follows: —

	Dec. 28, 1884.		Dec. 30, 1884.	
	Gas entering cylinder.	Gas issuing from cylinder. I.	Gas entering cylinder.	Gas issuing from cylinder. II.
Carbonic acid, ...	0.16	0.11	0.88	0.83
Oxygen, ...	0.69	0.48	0.50	0.62
Illuminants, ...	4.19	3.70	4.09	4.21
Carbonic oxide, . . .	6.37	6.13	5.77	5.37

It would thus appear that no considerable absorption had taken place. There was also no noticeable difference in the odor or in the illuminating power. No photometric measurements were made. As considerable gas had passed into the sand before the cylinder was perfectly tight, another experiment was subsequently made with fresh sand (experiment No. 5).

Experiment No. 3.

The cylinder was filled with a mixture of three volumes of slightly moist sand, and one volume of dry fire-clay, and the gas passed in slowly at the rate of one cubic foot in two hours. After six feet had passed through the apparatus, the issuing gas contained (Jan. 22, 1885): Carbonic acid, 1.13 per cent.; oxygen, 0.82 per cent.; illuminants, 4.40 per cent.; carbonic oxide, 7.42 per cent.

As there was evidently no absorption no analysis was made of the gas which entered.

Experiment No. 4.

The material was the same as used in the preceding experiment. Air was passed rapidly through the cylinder until the gas had been swept out. The gas was then allowed to flow in at the rate of one cubic foot in about two hours, and samples of gas were taken at intervals for analysis. The results were as follows: —

Amount of gas which had flowed in. Cubic feet.	Carbonic acid. Per cent.	Oxygen. Per cent.	Illuminants. Per cent.	Carbonic oxide. Per cent.	Marsh gas. Per cent.	Hydrogen. Per cent.	Nitrogen. Per cent.
2.	0.62	8.14	0.88	3.66	24.12	25.41	37.17
2.8	0.61	2.43	3.85	5.83	–	–	–
3.5	0.31	0.61	3.99	–	–	–	–
4.3	0.31	0.61	4.49	6.27	41.86	40.17	6.29
6.7	0.40	0.00	4.68	6.34	42.65	41.52	4.41
7.5	0.23	0.44	?	7.28	–	–	–
*	0.10	0.00	4.12	7.08	42.39	41.39	4.92

It appears in this case, also, that, as soon as the air in the cylinder had been displaced, there was no appreciable absorption of the hydrocarbons (illuminants) or of the carbonic oxide, the differences being within the range of the errors of experiment and the variations in the composition of the gas.

Experiment No. 5.

This was virtually a repetition of Experiment No. 2, with clean sand. In this case, however, the cylinder was tight at the beginning of the experiment. The gas was introduced at the rate of one cubic foot in from 25 to 40 minutes. The results of the examination were as follows: —

* Entering gas. Sample taken at close of the experiment.

Volume of Gas which had flowed in.	Carbonic Acid.	Oxygen.	Illuminants.	Carbonic Oxide.
Original gas, ...	1.09	0.25	5.17	5.67
2 cubic feet, ...	0.17	14.71	1.04	0.25
4 "	0.96	0.25	5.12	5.77
6 "	0.87	0.20	5.52	5.62

As soon as the absence of oxygen in the issuing gas showed that there was no longer admixture with air, it was not possible to discover any appreciable absorption of the hydrocarbons or of the carbonic oxide.

Experiment No. 6.

For this experiment the cylinder was filled with coal ashes from the steam boilers of the Institute. The gas was allowed to flow at the rate of one cubic foot in 50 minutes, and the issuing mixture began to burn when 0.7 foot had entered the apparatus. The samples of the issuing mixture which were examined gave the following results: —

Gas which had flowed in.	Carbonic Acid. Per cent.	Oxygen. Per cent.	Illuminants. Per cent.	Carbonic Oxide. Per cent.
0.7 cubic feet, ...	0.00	9.97	0.36	3.24
1.5 "	0.21	9.61	0 31	3.13
3.1 "	0.10	3.30	0.31	5.59
4.7 "	0.61	0.51	0.15	6.72
6.3 "	0.30	0.30	0.30	6.84
7.9 "	0.66	0.00	0.66	6.90
Original gas, ...	0.65	0.61	4.44	6.26
223 cubic feet, ...	1.07	0.15	5.68	6.19
550 cubic feet, ...	0.70	0.10	5.81	6.17
Original gas, ...	0.91	0.12	5.48	6.57

It is evident that, for a time, the gas was deprived almost completely of the heavy hydrocarbons or illuminants; with them the characteristic odor was also removed to a large extent. This action continued for a short time only for our cylinder was, after all, only 10 feet in length: but, in any case, this power of absorption is not, of course, unlimited. After eight cubic feet had passed the apparatus, the gas was allowed to continue to flow for some days as rapidly as the size of the tubes and the frictional resistance would allow; the two samples last taken had no doubt, the composition of the entering gas.

As the object of these experiments was a purely practical one, we have used in the investigations technical apparatus and methods of analysis and have expressed the results in conventional terms. That there is *absolutely* no absorption of the heavy hydrocarbons, or of some of them (*i. e.*, of the bodies which in the course of the analysis are removed by

fuming sulphuric acid), we do not assert. Moreover, all our experiments have been performed in the laboratory at approximately the same temperature. We hope to continue the investigation under a greater variety of conditions and using more delicate analytical methods, but our experiments will not be concluded in time to incorporate them in the present report, and, indeed, will be more appropriately published elsewhere.

Since this report was presented there have been published in Germany the results of an investigation into various practical questions connected with gas-supply, carried out at the instance of the German Association of Managers of Gas and Water Works.* Among other experiments is one where gas was passed through a pipe 14.45 meters (say 47 feet) in length, and 76 millimeters (say 3 inches) in width, filled with earth. The gas flowed at a rate of $4\frac{1}{2}$ meters per hour, so that it was in contact with the earth for 3 hours The pipe was much narrower than that used by us, and the air was completely displaced when a volume of gas equal to one-half the total capacity of the pipe (*i. e.*, equal to 38 liters) had entered. The entering and the issuing gas had nearly the same composition, there being no diminution of the so-called illuminants or of the carbonic oxide.

	Original Gas. Per cent.	Issuing Gas. Per cent.
Carbonic acid,	1.6	0.0
Oxygen,	0.6	0.0
Illuminants,	3.8	3.8
Carbonic oxide,	10.2	10.0
Marsh gas,	32.4	30 8
Hydrogen,	43.6	47.6
Nitrogen,	7.6	7.8

* Journal für Gasbeleuchtung, xxviii (1885), 644–654.

EPIDEMIC CHOLERA.

By the Health Officer.

EPIDEMIC CHOLERA.

The history of Asiatic or Epidemic Cholera in its march along lines of public travel from its home in India, has been so often detailed that a brief résumé only will be presented in this paper.

Accounts of epidemics in the eighteenth century are meagre and unsatisfactory, though there can be but little doubt as to its appearance in India in 1768 and also in 1780.

The *first* well-recognized epidemic was that of 1817, which began at Jessora, a district of Bengal, on the 19th of August, and was followed by 10,000 deaths in the succeeding two months. The number of victims in that year was estimated as at least 600,000. This epidemic spread to the eastward as far as Japan and the Indian archipelago, southward to Ceylon, and westward and northward to Arabia, Syria and the Mediterranean coast, finally touching the European frontier at Orenberg and Astrakhan in 1823.

The *second* outbreak began in 1827 in India, spread throughout Hindostan, and invaded Central Asia, prevailing even in Siberia. The following year it appeared in Orenberg, and along the eastern frontier of Europe, and in 1829 prevailed with renewed intensity on the borders of the Caspian Sea.

In 1830 Northern and Central Europe and also Egypt were invaded. The malady reached the shore of the Baltic Sea in June, 1831, the west coast of the continent in September, and England in October. In March, 1832, it had crossed to Ireland, and in the following June it appeared at Quebec, twenty-three months after beginning its progress through Europe. A few days later, June 18, there had been 2,516 cases and 437 deaths at Quebec. Thence its progress was rapid along the St. Lawrence to Montreal, and thence

westward by way of the great lakes to the Mississippi, appearing at New Orleans in October, where, out of a population of 55,084, the death-rate reached 147.1 per 1,000 for that year, in consequence of this pestilence.

In the same year it appeared at New York in June, at Albany, Philadelphia and Baltimore in July, and at Boston in August. In November it reached Charleston, S. C., and still later made its appearance at Havana and at Mexico. In 1837 it had quite generally disappeared as an epidemic from both hemispheres.

In 1842 the *third* great epidemic began an active career in India, extending thence eastward to Siam and the Eastern archipelago. In 1845 and 1846 the Punjab and Cabul were invaded, and afterward Ceylon. In May, 1846, it appeared at Aden, on the south coast of Arabia, and in the following month in Persia, where it prevailed with great severity.

Early in 1847 the epidemic invaded the Russian provinces west of the Caspian Sea, and Astrakhan, reaching Moscow in September, and St. Petersburg in June, 1848, Edinburgh in October, and appearing at New York December 2, the disease having broken out on a ship in mid-ocean. Another ship, leaving Havre with no cholera on board, met with the same misfortune in mid-ocean, and appeared at New Orleans with the disease on board, December 11 of the same year. Its progress was checked at New York until the following summer, and other Atlantic cities remained exempt during the same period. From New Orleans it spread with alarming rapidity along the Mississippi valley, and also across the continent to Mexico and the Pacific coast, reaching the latter in October, 1850. The whole number of deaths from cholera at New Orleans, from December 11, 1848, to August 4, 1849, was 3,501 out of a total of 6,868 from all causes for the same period. On the 20th of December a steamer arrived at Memphis, 900 miles distant, with cases of cholera on board, and from that date until July 15, 1849, there were in that city 290 deaths out of a total of 398 from all causes.

Another steamer from New Orleans arrived at Nashville, Tenn., December 27, having lost eight persons on the passage by death from cholera. Her arrival was followed during the next month by the appearance of cholera, and

305 persons died of the disease from that time till June 17, and in the following summer 301 more, making 606 in all.

Other towns in the neighborhood of New Orleans and on the Red River were also visited by the disease. Steamers also conveyed the disease to St. Louis, where it appeared January 5, 1849, and during that year 4,557 died from cholera out of a total mortality of 8,603, and an estimated population of 70,000. At Cincinnati it first appeared December 27, and destroyed in the two succeeding years 5,514 persons, out of a total of 9,214 deaths and an estimated population of 100,000.

It also attacked the cities of Louisville and Chicago, the latter city then having but 25,000 inhabitants, of which number 678 died of cholera. The town of Sandusky, Ohio, with a population of 5,667, was attacked July 8, and in thirty days lost 285 persons out of a total mortality of 307. The number of deaths at Buffalo (where the disease appeared May 30, upon a steamer from Chicago) was 858 in three months.

After its disappearance at New York, in consequence of efficient quarantine, in December, 1848, it broke out afresh in the following May, and from that date till November caused 5,070 deaths. The number of deaths from the same cause at Albany was 334, and at Philadelphia 1,020.

The *fourth* outbreak may be called that of 1854, although the disease had prevailed to a limited extent in various parts of the world between 1849 and 1854. During the latter year scarcely any country in Europe escaped its influence. In these six years, and even later, its history is that of a protracted invasion of the disease. Many cities of the United States were visited by the disease, though by no means so severely as in former epidemics.

The *fifth* outbreak, or that of 1866 and 1867, invaded Europe from the south, and in less than five months from its appearance at Alexandria, in Egypt, it had spread along the Mediterranean ports from the Black Sea westward with unparalleled rapidity of progress.

With the exception of a few cities, its fatality in the United States was not so great as in the earlier epidemics. Very much was done to combat the disease, and there is reason to believe that a quarantine of greater efficiency aided very

much in preventing its appearance along the Atlantic coast. The loss of life in St. Louis during this epidemic was severe, amounting to 3,527 deaths out of a total mortality of 5,379.

Massachusetts.

The epidemics of cholera which have invaded this State, were those of 1832, 1849, 1854 and 1866.* The general epidemic, which prevailed quite severely throughout the South and Southwest, in 1873 did not extend to the eastward beyond the Alleghanies, and Massachusetts has consequently been exempt from the disease for nearly twenty years.

With reference to Massachusetts, if the average of any twenty successive years of its history is considered, it will be seen that epidemic cholera is a comparatively unimportant disease in its effects upon the population. The sudden character of its invasion, and its alarming fatality in brief periods of time, are the chief elements which create popular apprehension as to the disease.

In none of the epidemics which have visited our shores have the cities and towns of Massachusetts suffered so severely as have the cities of the Southwest, — New Orleans, Memphis, Nashville, St. Louis and Cincinnati.

If the year 1849 is excepted, in no single year has cholera ever proved so fatal to the population of the State, as scarlet fever, whooping-cough, croup, typhoid fever, dysentery, cholera infantum, pneumonia, consumption, cancer or apoplexy.

A careful estimate shows that consumption has destroyed at least 200,000 of the people of Massachusetts in the fifty-five years from 1830 to 1884 inclusive, while epidemic cholera has destroyed in the same time not more than 2,100 of the same population, or less than one-hundredth part of that number.

Even in 1849 (its most fatal year) the deaths from cholera did not exceed one-third of those by consumption for the same year.

By reference to the accompanying table † the comparative fatality of cholera may be readily traced in its relation to

* The dates given are those of its appearance on this side of the Atlantic.

† Opposite page 324.

other intestinal diseases. It should be noted that the total 5,088 includes all the deaths from cholera morbus in the years intervening as well as those in epidemic years, which considerably outnumber those from epidemic cholera.

The custom which now prevails in most of the cities and towns of the State, of reporting annually, the number of deaths in each, together with their causes, in the annual reports of such municipalities, did not become general until a later period than that of the early epidemics. Hence, other and less reliable means must furnish the information from small localities. In Boston records of deaths have been kept since 1811, from which date until 1832 no deaths by cholera were recorded. The number from that date to 1866, inclusive, was as follows: * —

1832,	78	deaths.
1849,	611	"
1850,	1	"
1851,	5	"
1854,	261	"
1858,	1	"
1862,	2	"
1863,	1	"
1865,	4	"
1866,	11	"
Total,	905	"

In the epidemic of 1832, active and energetic measures were taken in Boston, Salem, and other cities, in the direction of their public sanitation. The health authorities, learning of the destructive ravages of the disease in other places, were watchful of the interests of their own municipalities, and ordered inspection of dwellings and premises. Associations for attendance upon the sick were organized, and more stringent sanitary regulations were adopted and enforced. Retail liquor shops were also ordered to be closed. Hospitals were established in Boston on Fleet

*Report of Dr. Wm. Read, City Physician, for the year ending April 1, 1867. This document also contains the valuable report to the Sanitary Conference at Constantinople (translated by Dr. S. L. Abbot), in which are treated the questions relating to the origin and genesis of cholera, its endemicity and epidemicity in India its transmissibility and propagation, the influence of means of communication, the influence of hygienic conditions, and the question of immunity of localities.

Street, Fort Hill, corner of Pinckney and Cedar streets, Tremont and Boylston streets, and at South Boston.

The health commissioners of that date were Drs. John C. Warren, Benj. Shurtleff, Geo. C. Shattuck, George Hayward and John Randall.

In advance of the appearance of the disease, Gov. Levi Lincoln had proclaimed August 9 as a day of public fasting. Early in the season Drs. Jacob Bigelow, John Ware and John B. Flint went as a deputation to New York city for the purpose of making observations with reference to its prevalence there.

As is quite common with epidemics of cholera, intestinal disorders were more frequently reported than usual in the early summer months. At the State prison in Charlestown a sudden epidemic prostrated 118 persons on the 5th of August, all of whom recovered, and a similar but milder attack was reported at the House of Industry in South Boston. The first cases in Boston were reported August 15, and proved rapidly fatal; one at South Street Place, and another in Atkinson Street (now Congress).

In a report of the consulting physicians of Boston during this epidemic, the use of pure water is urgently advised, and in a significant note it is also stated that "this article is with difficulty obtained in this place."

Among the advertisements in the papers of that season may be found such disinfectants as chloride of lime and sulphur, and also an empirical remedy, still used to some extent, called the Vinegar of the Four Thieves, which had a singular traditional reputation. An instrument devised for the prevention of cholera, not unlike a warming-pan, was also proposed. *

From August 18 to August 22, eight or more cases were reported as occurring at North Andover, one only of which was fatal.

August 24. The third case reported in Boston was that of a boy 10 years old, on Carver Street.

August 27. Three cases were reported from Pepperell, two of which proved fatal; and, on the same date, one in

* Boston Advertiser and Patriot, August, 1832.

Haverhill, followed on the next day by another in the same town.

September 1. The fourth case in Boston occurred on Ann Street (now North); a woman of intemperate habits.

September 2. One case in Southbridge. A case reported in Weston.

September 6. The fifth case in Boston; a vagrant woman, found ill in the street, and said to have come from Newburyport. She died.

September 10–12. Six cases were reported from the neighborhood of Carver, Eliot and Essex streets.

September 12. An order was issued by the Board of Health to work the pumps in houses one-half hour to flush the drains.

From this date, September 12, to September 31, several more cases occurred.

October 1. All hospitals, except the Tremont Street hospital, were ordered closed, and after that date but few cases occurred. One reported October 1, and one October 4.

October 2. One case reported from Taunton.

One of the first cases in Boston was that of a man who had attempted to remove an obstruction in his house-drain. In this region (the neighborhood of Eliot Street) the sewerage was in a bad condition, and steps were taken in midsummer to remedy the evil by repairs and alterations, which appear to have aggravated the disease. Such measures taken in the midst of an epidemic, instead of in anticipation of it, are not unfrequently followed by an increase in the virulence of the epidemic.

So far as can be ascertained from records consulted, the number of deaths from cholera in Massachusetts, in the epidemic, was not more than 150.

For information relative to the next outbreak of cholera, in 1849, valuable data may be obtained from the registration reports which began with the year 1842. The term cholera, however, in these reports is employed in its general sense, and includes the disease commonly known as cholera morbus, which is occasionally fatal, in addition to epidemic cholera. Hence, deaths are reported from cholera in every

year from the beginning. The average number is considerably increased in each one of the cholera years, 1832, 1849, 1854, and 1866. An accurate record of the whole number in the State cannot, therefore, be had. The number may be estimated approximately by deducting the average for a series of successive years from the number reported in each epidemic year.

A table is herewith given of the deaths from diarrhæal diseases, showing their prevalence in each of the counties of the State as shown by the registered deaths in each.

A chart is also given (reproduced from the Boston Medical and Surgical Journal of Nov. 14, 1849), showing the prevalence of the disease in Boston through the epidemic from June 8 to October 13, 1849.

In this chart each inch in height indicates 64 deaths, and each space of $\frac{3}{8}$ inch from left to right indicates a period of one week.

The upper light line represents the total mortality.

The heavy line represents the deaths from bowel diseases.

The lower light line represents the deaths from cholera.

The upper dotted line represents the deaths among foreigners and their children.

The lower dotted line represents the deaths among Americans.

Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.	Cholera.	Cholera Infantum.	Diarrhœa.	Dysentery.
14	10	22	†	–	1	11	8	23	86	198	46	172	245	1,074
11	6	98	–	1	–	22	6	44	3	336	41	268	53	2,135
17	6	96	658	62	113	316	26	56	3	510	1,188	360	209	2,455
4	8	49	10	36	50	152	9	54	7	231	65	252	172	1,188
17	4	78	21	77	58	142	7	66	9	257	64	383	148	1,674
16	4	45	11	73	57	124	13	51	6	196	60	377	132	1,018
21	12	58	34	136	36	145	4	67	23	138	90	535	243	1,046
21	10	58	283	94	57	154	24	100	14	202	765	528	221	1,159
32	28	80	11	234	22	151	5	94	24	158	70	746	315	1,131
14	15	54	2	213	26	127	6	60	34	135	55	555	262	930
20	13	23	2	280	20	93	3	57	10	76	38	631	135	715
19	9	38	11	238	29	98	12	87	22	110	66	720	175	752
32	26	31	8	249	29	64	9	104	18	77	66	831	151	612
3	12	25	26	274	62	70	11	119	29	54	99	1,078	274	441
8	24	35	20	314	58	55	9	128	36	67	79	1,266	272	532
1	12	30	26	240	97	75	8	100	41	76	85	900	340	479
3	59	91	32	352	109	106	24	129	89	134	121	1,164	671	1,156
2	38	80	14	286	139	122	15	160	89	106	95	1,198	589	1,186
[illegible]	32	86	25	266	127	164	13	149	55	758	84	1,154	464	1,548
[illegible]	13	31	62	273	89	140	19	107	16	160	192	1,078	304	949
[illegible]	6	16	15	243	88	81	13	140	14	101	64	966	270	658
[illegible]	2	22	25	487	104	116	11	172	17	102	117	156	293	685
[illegible]	10	23	21	367	122	72	12	174	22	63	95	1,424	305	481
	4	22	20	532	214	69	14	269	22	79	107	1,914	457	471
	4	19	33	531	130	62	5	231	16	69	96	1,718	344	389
	10	23	32	773	152	54	22	356	34	90	137	3,254	464	564
	9	13	32	627	115	58	11	270	15	57	106	2,553	353	435
	4	15	28	701	155	55	10	242	27	56	95	2,322	398	366
	9	38	27	722	183	92	11	300	26	51	94	2,606	413	437
	10	26	19	553	170	98	11	219	20	77	91	2,087	335	417
	4	18	16	576	181	159	8	190	19	75	60	1,927	343	580
	5	16	14	391	160	221	13	166	24	28	68	1,573	365	602
	7	19	23	392	186	109	5	141	31	30	77	1,349	370	372
	8	17	35	536	218	131	19	263	45	60	116	2,118	480	395
	9	16	17	477	206	97	6	198	38	23	68	1,861	458	360
	7	24	35	532	191	81	23	288	41	41	136	2,159	488	398
	9	14	18	563	239	87	13	241	37	41	84	1,941	516	336
	7	17	45	533	240	57	10	251	42	38	108	2,081	522	254
	.	.	.	.	.	.	.	.	.	.	5,088	49,620	12,549	30,380

‡ Eight months ending Dec. 31, 1848.

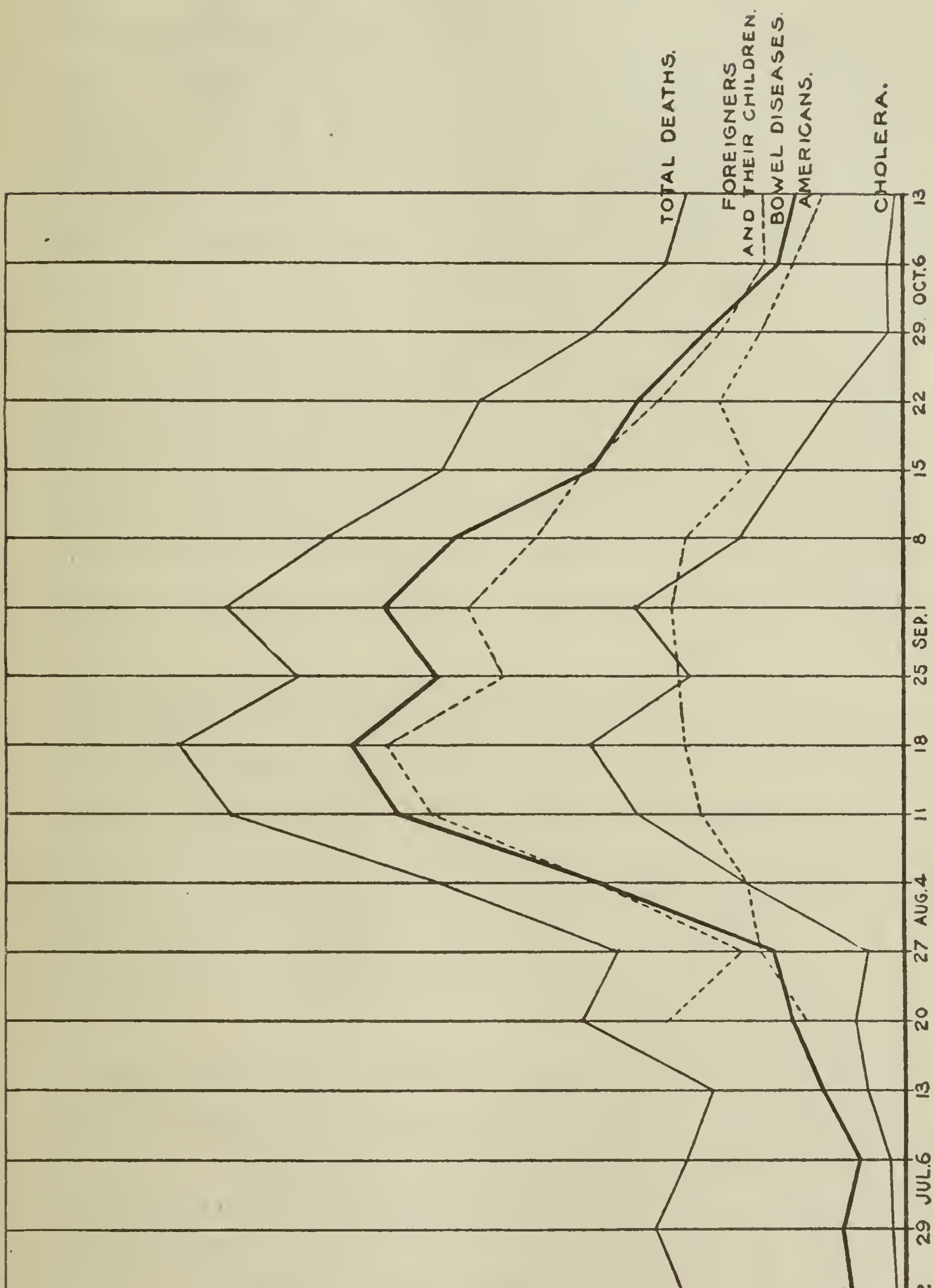

CHART ILLUSTRATING PREVALENCE OF CHOLERA IN BOSTON IN 1849.

An accurate record of the prevalence of cholera in Boston in this epidemic may be found in the full and complete report of the Internal Health Department for the year 1849.* This document has not unfrequently been misrepresented in later years by superficial readers, who have reported it as stating the number of cases in the city as 707, and the deaths 611. These figures would give the impression of an excessive mortality. The exact words of the report are as follows: "The subjoined statistics furnish the history of the origin of 707 cases, 611 of which were fatal."

The 96 cases which are reported as having recovered were all treated at the hospital, while the deaths include all which occurred in the city. Of the considerable number which recovered outside the hospital no accurate record can be obtained, since there was then no legal requirement for the reporting of infectious diseases. Physicians who were then in practice estimate the whole number as between two and three thousand cases.

The map and the accompanying tables in this report show very clearly the existence and location of two or three distinct foci of the disease: one at the North End, where the outbreak was mainly confined to the neighborhood of Hanover, Prince and Ann (North) streets; another at Fort Hill, between Oliver and Broad streets, and also along Sea Street (now the southerly end of Federal Street). Other cases were scattered here and there, principally at the West and South ends of the city.

The condition of the three localities mentioned was remarkably filthy, as would appear from the graphic illustrated description in the latter part of the report.

In the paper of Dr. J. W. Stone, already mentioned, it is stated that one small section of the city contained 3,151 inhabitants, or one to each seven square yards.

Charlestown and Roxbury also suffered quite severely from the same epidemic, and as these cities were not only distinct from Boston at that time, but were each in separate counties, the deaths from cholera in them are found included in those of the Norfolk and Middlesex reports in the table.

* Report on the cholera in Boston in 1849. Internal Health Department. Containing, also, the report of Dr. Henry G. Clark, city physician. Boston, 1850, p. 182.

In like manner Cambridge, Lowell and Springfield also suffered; the first deaths at Springfield being reported July 5, and at Lowell, August 23, followed by others on the succeeding day.

In Lynn the first case occurred August 10, and proved fatal. This person, an emigrant, was removed to the almshouse, at which place four other persons were attacked soon afterward, all of whom died. Between August 10 and August 30 there were sixteen deaths at Lynn and Swampscott. Nine occurred at the almshouse.*

In Hampden County, at Ireland Depot, now a part of Holyoke, an emigrant population had settled, numbering about 2,500, among whom an outbreak of cholera began July 21 and lasted till September 1, the greatest number in one day being fifteen. A writer in the Boston Medical and Surgical Journal of Nov. 14, 1849, says: "It was not till 100 had died that measures were taken to stay its progress." If the figures of the registration report for that year are correct, this estimate must be too large.

The number of deaths from cholera in Massachusetts, in the epidemic of 1849, was not far from 1,100.

The epidemic of 1854 in general was much less severe than that of 1849 in Massachusetts, and with the exception of Fall River, and a few of the large towns, the number of deaths was comparatively small.

The first death in Boston occurred June 9, and the whole number of deaths from that date until October 1, was 261, or less than half the number which proved fatal in 1849.

A remarkable outbreak, similar to that of 1832, took place at the State prison in Charlestown, July 28, a large number of the convicts being taken ill at once; none, however, proved fatal.

The number of deaths in Charlestown was about fifty in all.

In Fall River a sudden outbreak followed a *wake*, causing twenty deaths within a few hours. These were in a filthy locality and occurred August 25. By the 30th of August (five days afterward), thirty-six deaths in all had taken place in the same city, and five or six in Taunton.

* Report of sanitary condition of Massachusetts. Boston, 1850, p. 522.

One was reported from Dennis, a sea captain who had just arrived in port.

About the same date several cases occurred at Woburn, among employees of the railroad company and others. Four cases proved fatal, including one of the physicians of the town (Dr. Aug. Plympton).

The 13th Registration Report (1854) says of this epidemic: —

"This year (1854) the whole number of deaths throughout the State, caused by cholera, was reported to be 765, an increase of 675 over that of the preceding year, being 3.69 per cent. of all the deaths from known causes, when the percentage for 1883 was only .46 per cent. In the counties of Suffolk, Bristol and Hampshire * there were severally 283, 173 and 136 deaths caused by this very fatal malady, and in each of the other counties it exhibited more or less mortality. Without doubt, several of the deaths attributed to cholera should have been classed under other diseases."

Twelve years later (1866), cholera again made its appearance in the State, the first case being that of a soldier who came home from New York city on furlough, and was taken ill during his passage. Cholera was prevailing at the same time (July 18) in New York city, especially at the barracks where he had been stationed. Other cases soon followed. In the words of Dr. Read's report, "Although the victims have not been many, comparatively speaking, it has taken from this community those who could ill be spared, and whose loss is a public misfortune." The number of deaths in Boston was but eleven, among which number were Drs. Aug. A. Gould and Wm. E. Townsend.

Active measures were taken in other cities and towns, and the disease gained but little foothold outside of Boston, Roxbury, Cambridge, and their immediate neighborhood.

The total number of deaths from the disease in Massachusetts in 1866 was probably not more than 150.

The extensive epidemic which prevailed throughout the Mississippi Valley and the Southern States in 1873, did not extend to the eastward as far as Massachusetts.

An extended discussion of the subject of the *causation* or *etiology* of cholera will not be attempted within the limits of

* This is clearly an error and should read *Middlesex* instead of *Hampshire.* Three deaths only from cholera were reported for Hampshire County in 1854.

this paper. Like typhoid fever, it is undoubtedly a true filth disease. It must also be acknowledged, as in the case of typhoid fever, that filth *per se* cannot be said to produce it, but rather, under favorable conditions, furnishes the soil for its development. "The existence of living germs explains in a satisfactory manner the origin and the epidemic extension of the disease. Evidently the *materies morbi* is capable of self-multiplication external to the human body; and this multiplication is conditioned by circumstances of the same kind as those which influence the development of the lowest organisms — heat, moisture, and the presence of organic material to serve as nutritive pabulum for the hypothetical germ." *

This expression of opinion, made but a few months previous to the publication by Prof. Koch of the discovery of the comma-bacillus (July, 1884), was directly in harmony with that discovery. Whether these living germs are the specific cause of disease, or are only a concomitant or associated fact, is a question which can hardly be considered as settled.

In the valuable report upon the epidemic of 1873, published by Congress, Surgeon E. McLellan, who had charge of the report upon the causes of the disease, states distinctly the following propositions:—

Proposition 1. — That Asiatic cholera is an infectious disease resulting from an original poison, which, gaining entrance into the alimentary canal, acts primarily upon and destroys the intestinal epithelium.

Proposition 2. — That the active agents in the distribution of the cholera poison are the dejections of persons suffering from the disease in any of its stages. That in these dejections there exists an organic matter which, at a certain stage of decomposition, is capable of reproducing the disease in the human organism to which it has gained access.

Proposition 3. — That cholera-dejecta coming in contact with and drying upon any objects, such as articles of clothing, bedding and furniture, will retain indefinitely their power of infection. That in this manner a sure transmissibility of the cholera infection is effected, and that a distinct outbreak of the disease may occur by such means at great distances from the seat of the original infection.

* "Bacteria," by Dr. Antoine Magnin and Geo. M. Sternberg, M.D , F.R.M.S. New York, 1884, p. 285.

Proposition 4. — That the specific poison which produces the disease known as cholera originates alone in India, and that by virtue of its transmissibility through the person of infected individuals, or in the meshes of infected fabrics, the disease is carried into all quarters of the world. That cholera has never yet appeared in the Western Hemisphere until after the route of pestilential march has been commenced in the Eastern World, and that its epidemic appearance upon the North American continent has invariably been preceded by the arrival of vessels infected with cholera patients, or laden with emigrants and their property from infected districts.

Proposition 5. — That the respiratory and digestive organs are the avenues through which individual infection is accomplished; that through the atmosphere of infected localities cholera is frequently communicated to individuals; that water may become contaminated with the specific poison of cholera, from the atmosphere, from surface washings, from neglected sewers, cesspools, or privies, and that the use of water so infected will induce an outbreak of the disease.

Proposition 6. — That the virulence of a cholera demonstration, the contagion having been introduced into a community, is influenced by the hygienic conditions of the population, and not by any geological formation upon which they may reside.

Proposition 7. — That one attack of cholera imparts to the individual no immunity from the disease in the future, but that the contrary seems to be established.

These propositions, with possibly the exception of the third, which relates to the virulence of dried dejecta, appear to be sustained by the researches of the past twelve years, which have elapsed since their publication.

Water Supply.

The danger of infection through the medium of water supplies, both public and private, cannot be doubted. The testimony of Simon and Buchanan, and also the observation of medical officers of health in many epidemics, are of undoubted value in support of this opinion.

The observations of Mr. Simon with reference to the water supplies of London are very conclusive. In 1854, two companies, the Lambeth and the Southwark and Vauxhall, supplied a population of 365,000 people, about evenly

divided. Of those drinking the water of the former, which was comparatively pure, the mortality rate was 3.7 per 1,000. Of those drinking the latter, an impure supply, the death-rate was 13 per 1,000.

"The population using the dirty water appears to have suffered three and one-half times as much mortality as the population drinking other water."

The Prevention of Cholera.

A disease so fatal, and one which becomes rapidly infectious, especially in crowded populations, is a matter of prime importance. Its causes and mode of propagation are such as to furnish definite indications for its prevention.

1. — Quarantine.

The history of the five principal epidemics of cholera which have invaded the United States furnishes abundant proofs of the direct transmission of the disease by means of ships bringing passengers from foreign ports. The necessity of subjecting such vessels to thorough disinfection, as well as their passengers and their baggage, is obvious.

2. — Cleanliness.

Of air, water, soil, dwelling, and of persons. It is established beyond question that filth, and especially moist filth, furnishes the proper conditions for the development of cholera. Hence the imperative necessity of its removal. It is also desirable that measures to that end should be taken in advance of an epidemic, and not during its prevalence. Even though cholera should not prevail, the adoption of such measures is also preventive against other filth diseases.*

3. — Purity of Water Supply.

This must be acknowledged as one of the first of all measures in its importance. The serious outbreak of cholera in Boston, in 1849, began a few months only before the introduction of Cochituate water, and a great number of private wells were still used in different parts of the city, many of them having been in use for a century or more, in locali-

* See quotation from circular of Local Government Board, p. 336.

ties where the soil was impregnated with the filth of generations, in the midst of a dense population.

Even with the possibilities of pollution of its public supplies, the danger is far less, with the enormous dilution of the public water, than it is in the case of private wells, each with its few gallons only, situated in the immediate neighborhood of polluting sources.

As a preventive measure of decided value, the closing of wells by health authorities has been recommended, and also enforced, in Brooklyn, Boston and other cities, where such wells were shown to furnish water of more than doubtful quality, and which, in consequence of their location with reference to sources of pollution, were beyond the possibility of remedy.

While this is true in regard to private water supplies, it is also of much greater importance that the public supplies should be freed from every possible source of pollution, and it is incumbent upon the municipalities of the State to lose no time in taking measures to remedy every source of danger.

In the report of the city physician of Boston, 1866, already cited, this point is recognized (p. 33). "Other strong evidence bearing on the question of its propagation, and which tends to sustain the general assertion that water is the great vehicle of cholera transmission, is to be found in the comparative immunity, during the past season, which those cities of the United States have enjoyed which are supplied with water by a system which practically insures freedom from admixture with sewage."

4. — Temperance.

The importance of a careful observance of regular habits with reference to food and drink, as to quantity, quality and times of meals; in short, the practice of temperance, not only in its restricted sense, as relates to the use and abuse of alcoholic stimulants, but also in its broader sense, as related to everything used for the nourishment of the body, whether of food or drink, are especially urged, as shown and proven by the experience of past epidemics. The food should be of a plain, nutritious and easily digestible character. Specially should the milk supply be without suspicion; and

the same caution is applicable to the ice supply, since it is true that the germs of disease, although arrested by low temperatures, are not destroyed.

With these considerations in view, the Health Department in 1884 issued a circular to the local health authorities of the State, embodying such suggestions with reference to the probable or possible appearance of the disease as the experience of past epidemics had indicated.

The first edition of this circular was soon exhausted, and in the following summer it was revised and issued in the following form: —

Suggestions relative to Epidemic Cholera, revised June, 1885.

[*A Circular from the State Board of Health, Lunacy and Charity.*]

In view of the appearance of epidemic cholera, during the summers of 1883 and 1884 and also of the present year, in foreign ports and cities, and recognizing the possibility of its occurrence in the cities and towns of Massachusetts, the following circular is issued by the State Board of Health, Lunacy and Charity, for the guidance of local boards of health and all others whom it may concern.

The portability of the disease, the possibility of its rapid development, the importance of public and private sanitation, and the value of disinfection are established.

Observation in past epidemics upon both continents shows that the disease may be carried from one place to another by persons ill with cholera. Its carriage by healthy persons coming from infected places is also probable. Experience also teaches that the presence of imported cases is not likely to prove dangerous to any community, if the place receiving the infection has had, and *continues to have*, thorough sanitary care and supervision.

The *contagium* of cholera is not like that of the eruptive fevers, small-pox and scarlatina, and if reasonable care is taken, there is but little risk that the disease will spread to the attendants upon the sick. It has, however, a peculiar infectiveness which, when the local conditions are favorable, can operate with terrible force.

The discharges from the bowels are without doubt the chief source of infection. In proportion as carelessness and neglect are permitted in the disposal of these discharges, the disease is liable to spread. Under ordinary circumstances, it is probable that a patient suffering with epidemic cholera has no power to infect

others, except by means of such discharges. Nor is it probable that he has any power of infecting at all, except in so far as particles from these discharges may infect the food, water or air which others consume.

In order to understand what the facilities are for spreading infection, the following considerations relative to the modes of propagation of cholera should be borne in mind: —

a. By leakage from privy vaults, and cesspools, and also by surface drainage, the infective material of the cholera discharges may gain access to wells, or public water supplies, and thus impart to great volumes of water the power of propagating the disease.

b. The careless disposal of choleraic discharges, by suffering them to pass into public or private water closets, sewers or cesspools, without disinfection, infects the sewage therein contained, and possibly the effluvia evolved by such sewage.

c. The infective power of cholera discharges attaches to bedding, clothing, towels, and other articles which have been soiled with them, and renders them as likely to spread the disease in distant places to which they are sent, as in like circumstances the patient himself would be.

When these possible modes of infection are appreciated, it will be readily understood that a single case of cholera, perhaps of the mildest sort, may, if local circumstances are favorable, exert a terribly infective power on considerable masses of population.

The principal dangers to be avoided as favoring the spread of cholera may be enumerated as: —

First and mainly. Infection of water supplies by house sewage, as where overflow, leakage, or filtration takes place from sewers, drains, privy vaults, cesspools, or surface drainage into rivers, brooks, streams, springs, ponds, wells, cisterns or reservoirs from which drinking-water is taken, or into the soil in which such water supplies are situated.

Second. The danger of breathing foul air which is contaminated with effluvia from the same sources.

It is therefore recommended that immediate and thorough examination of the public water supplies should be made by local boards of health, especially when such supplies are liable to the least suspicion of contamination. If pollution is discovered, immediate measures should be taken for preventing its continuance. The existence of at least eighty public water supplies in Massachusetts, furnishing water to 1,200,000 inhabitants, is sufficient reason for the exercise of the greatest care in this direction.

The surroundings of private wells should also be examined with reference to possible sources of infection. Careful attention

should also be given to the removal of house refuse, offal and garbage, and also to the accumulation of filth in neglected places. Thorough inspection of house plumbing and drainage is recommended, with special attention to leaks, imperfect traps, and all other defects by which offensive smells may gain access to interior apartments. Cellars, out-houses, stables and hog-sties should be thoroughly and frequently cleansed, and the liberal application of whitewash is recommended in the same places.

Since it is established that the development of cholera infection is favored by the presence of moisture, it is desirable that wet places in the immediate neighborhood of dwellings should be remedied by drainage or other available measures, and especially should cellars with damp floors and walls be made dry by drainage and thorough ventilation.

Local boards of health are urged to make thorough inspection of the water supply and drainage of all public institutions, school-houses, railroad depots, picnic and camp grounds, travelling shows and all places where large collections of people are accustomed to assemble.

The organization of local boards of health in every town and city is a matter of the highest importance. The most efficient and satisfactory boards have invariably been those who were elected solely for sanitary purposes and were independent in their action. To such boards the Public Statutes give absolute authority for the control of local sanitary conditions.

It is important that local boards should act without delay, and use every endeavor to place their cities and towns in as thorough a sanitary condition as possible.

At the conference of State boards of health, held at Washington in December last, the following excellent suggestions were adopted as indicating the proper line of work for local authorities, and are herewith recommended: —

1. The abolition of pump-wells in cities, wherever connection with the public water service can be made.

2. The abolition of privy vaults wherever sewer connections can be made.

3. The filling and disinfection of stagnant ponds or pools.

4. The supervision of sewers and plumbing.

5. Inspection of tenement houses.

6. Inspection of food supply, especially of milk, meat and vegetables.

7. Removal of garbage and kitchen refuse.

8. Garbage not to be used for filling vacant lots.

9. The attention of all public institutions to be directed to the necessity of cleanliness.

10. The necessity of taking every possible measure for the prevention of cholera and of giving immediate notice to health authorities in case of local outbreaks.

"Measures of cleanliness, taken beforehand, are of far more importance for the protection of a district against cholera than removal or disinfection of filth after the disease has actually made its appearance.

"It is important for the public very distinctly to remember that pains taken and costs incurred for the purposes to which this circular refers, cannot in any event be regarded as wasted. The local conditions which would enable cholera, if imported, to spread its infection, are conditions which, day by day, in the absence of cholera, create and spread other diseases, — diseases which, as being never absent from the country, are in the long run, far more destructive than cholera; and the sanitary improvements which would justify a sense of security against any apprehended importation of cholera would to their extent, though cholera should never reappear in this country, give ample remunerative results in the prevention of those other diseases." — *Circular of Local Government Board of England, July, 1883.*

The amendment to the Public Statutes, enacted by the legislature of 1884, relative to diseases dangerous to public health, is as follows: —

Chapter 98. Acts of 1884.

Section 1. When a householder knows that a person within his family is sick of small-pox, diphtheria, scarlet fever or *any other disease dangerous to the public health*, he shall immediately give notice thereof to the selectmen or board of health of the town in which he dwells, and upon the death, recovery or removal of such person, the rooms occupied and the articles used by him shall be disinfected by such householder in a manner approved by the board of health. Any person neglecting or refusing to comply with either of the above provisions shall forfeit a sum not exceeding one hundred dollars.

Sect. 2. When a physician knows that a person whom he is called to visit is infected with small-pox, diphtheria, scarlet fever or *any other disease dangerous to the public health*, he shall immediately give notice thereof to the selectmen or board of health of the town; and if he refuses or neglects to give such notice, he shall forfeit for each offence not less than fifty nor more than two hundred dollars

Sect. 3 The boards of health in the several cities and towns shall cause a record to be kept of all reports received in pursuance of the preceding sections, and such record shall contain the names of all persons who are sick, the localities in which they live, the diseases with which they are affected, together with the date and the names of the persons reporting any such cases. The boards of health shall give the

school committee immediate information of all cases of contagious diseases reported to them according to the provisions of this act.

SECT. 4. The secretary of the Commonwealth shall furnish the boards of health with blank books for the record of cases of contagious diseases as above provided.

SECT. 5 Sections seventy-eight and seventy-nine of chapter eighty of the Public Statutes are hereby repealed.

HOUSE OF REPRESENTATIVES, March 17, 1884.

Passed to be enacted.

INDIVIDUAL PRECAUTION.

The following precautions are recommended to private individuals, and especially to householders:

1. *Domestic Water Supply.* The supply of water for household purposes should be pure, and especially free from contamination by house drainage. Wells located in close proximity to privies and cesspools are always open to suspicion of contamination. If a public water supply of known purity is at hand, it would be better to make immediate connection with it than to trust to a private well, the question of safety being very largely in favor of the former.

2. *Food Supply.* Particular care should be taken in the use of food, especially as to the fresh and ripe condition of fruits and vegetables. Excesses in eating and drinking should be avoided, particularly in conditions of fatigue.

The milk supply should receive special attention. To say nothing of the common practice of diluting with water, the milk-cans are too often rinsed with water drawn from a well situated in some filthy stable-yard or cellar.

It is also desirable that the domestic ice supply should be free from contamination.

3. Every householder should carefully attend to the condition of the water closets, privies, cesspools, drains, cellars, stables, yards, outbuildings and sheds upon his premises, and cause them to be kept in a cleanly condition, and also use in connection with them such disinfectants as are hereafter advised, whenever they may be necessary.

DISINFECTION.

The following disinfectants are recommended:

For *clothing, towels, bedding and other textile fabrics*, — either of the following:

A solution of bichloride of mercury, 1 part to 1,000;
Carbolic acid, 1 part to 30 of water.

Subjecting to a temperature of at least 212 F. (100 C.) for an hour, either by boiling or baking, is recommended as quite efficient when practicable. It would be better still to burn all soiled clothing

For *water closets, urinals, sinks and cesspools*, —

Solution of bichloride of mercury [corrosive sublimate], 1 part to 1,000 of water.

Solution of carbolic acid, 1 part to 30 or 40 of water.

Solution of chloride of zinc, 1 part of liquor zinci chloridi, U. S. P., to 200 of water.

For the *disinfection of excreta*, —

The choleraic discharges should receive special attention.

It is therefore recommended that such discharges be received in metallic or earthen vessels and treated with the solution of bichloride of mercury, 1 to 1,000, or by the chloride of zinc solution.

Undoubtedly the better mode of treating the discharges is by complete destruction by fire. For this purpose, when practicable, the erection of small furnaces, stoves or crematories is desirable wherever cholera hospitals are established. In consequence of the fluidity of the excreta it would be preferable to receive them into sawdust, or other light combustible material previous to burning.

Bodies of persons deceased from cholera, —

The bodies of cholera victims should be wrapped in cloths saturated in a solution of bichloride of mercury previous to burial.

Disinfection of houses. — For this purpose, sulphur is recommended, as advised in previous circulars of the board. Effective disinfection, by burning sulphur, requires from two to three pounds to each space of one thousand cubic feet. The sulphur should be broken in small pieces, burned over a vessel of water or sand, so as to avoid danger from fire, and, if the room is large, it should be put in separate vessels in different places. The room should be tightly closed for six hours, and then aired; it is better that the room should be warm than cold. Of course, efficiently disinfected air is, during the process of disinfection, irrespirable. Most articles may be disinfected in this way, if hung up loosely in the fumigated chamber, although it would be an additional safeguard to expose anything thick, like a bed mattress, to prolonged heat at a temperature of 240° F.; and, indeed, *heat* must, with our present knowledge, be considered *the best disinfectant.* With this end in view, local boards of health are advised to procure furnaces and laundries, as is commonly done in other countries, to be used for the sole purpose of disinfecting articles which have been exposed in the infectious diseases, as recommended in the Ninth Annual Report of the State Board of Health (pp. 255 *et seq.*). Of course,

a much simpler disinfecting furnace than that described will answer every purpose. For ordinary use, in disinfecting *houses*, the sulphur process is best.

[An excellent report on disinfection has been issued by the American Public Health Association, containing the results of recent careful investigation on the subject.* Copies of this report will be forwarded on application.

It is especially desirable that local boards of health should lend their aid in carrying out the provisions of the statutes relative to the reporting of cases of cholera in their respective cities and towns, should such occur, and for such purposes the systematic division of cities and towns into sanitary districts for convenience in matters of inspection and of record, is desirable.

The State Board would also request that in case of any outbreak of the disease, the fact may be reported to them without delay.]

In view of the recognized modes of transmission of the disease along the routes of public travel, it was deemed important that the following special notice should be issued to railroad and steamboat corporations, calling their attention to the necessity of taking precautions to prevent infection along their respective lines of travel.

OFFICE OF THE STATE BOARD OF HEALTH, LUNACY AND CHARITY,
HEALTH DEPARTMENT,

STATE HOUSE, BOSTON, April, 1885.

DEAR SIR:—In view of the apprehended approach of Asiatic Cholera during the coming season, and also in consequence of its tendency to communication along lines of public travel, it is especially desirable that the Superintendents of Railroads and Steamboat lines, whose routes, stations, ports of departure and entry are within the limits of this Commonwealth, should immediately take and maintain such precautions as shall prevent infection along the routes under their charge, and that, to this end, all railway stations, yards and grounds, passenger cars, steamboats and boat-landings should be put in thorough sanitary condition.

Water-closets, which not unfrequently at stations are public nuisances, should be cleansed frequently and thoroughly disinfected. There should be no possible communication between them and the public water supplies in their neighborhood.

* See page 345.

The supervision of stations used as restaurants especially requires attention, with reference to the character and quality of the food supply, the source of the drinking-water and the disposal of the garbage.

Railroad cars in particular require constant supervision. The water-closets attached to cars and boats should receive special care with reference to cleanliness and disinfection.

Special attention should be paid to the sources of the water and ice dispensed upon passenger cars and steamers.

Stagnant water along railroad tracks and road-beds should be removed by drainage or filling when resulting from the neglect of corporations.

Railway and steamboat corporations and the travelling public have a common interest, and should unite in securing the most efficient co-operation for the common good.

Respectfully yours,

SAM'L W. ABBOTT.
Health Officer.

To the Superintendent,

DISINFECTION.

DISINFECTION.

The measures recommended for disinfection in the circular on page 337 were first published previous to the publication of the preliminary report of the American Public Health Association, which we also append to this paper.

During the past few years the entire subject of disinfection has undergone careful revision and taken its place as one of the most important topics of preventive medicine. Experimentation on both sides of the Atlantic has given to the world much more exact and definite intelligence with reference to the comparative value of substances employed for disinfection. It has also made it necessary to eliminate certain articles of former reputed value, and to elevate others, hitherto considered unimportant, to a high rank in disinfecting power.

The exact meaning of the term disinfectant is often misconceived.

Certain principles should be recognized with reference to disinfection.

1. A true disinfectant is a substance which disinfects or destroys infection or infectious material.

2. There can be no true disinfection which is not complete and thorough.

3. Disinfectants may be used for various purposes, or in various modes. Some of those which are most efficient when used in certain modes being practically useless in others. As, for example, the disinfection of apartments, of persons, of clothing, of excreta, of drains and sewers.

4. Some of the most efficient disinfectants are also more or less poisonous and should be used with great caution.

5. Decided odor in a disinfectant is not an essential proof of its efficiency, nor is the destruction of odor in infectious material a proof that its infecting power is destroyed.

Of the three classes of substances known as deodorizers, antiseptics and disinfectants, the latter only should be depended upon for the prevention of infectious diseases.

In this connection the establishment of public disinfecting stations for cities and large towns is a measure worthy of careful consideration. Such places are in use in many of the large cities of Europe, — Berlin, London, Paris, Nantes,* Liverpool† and Nottingham. Apparatus for this purpose may be either stationary or portable, as in the apparatus devised by Mr. Fraser, which may be mounted upon wheels and moved from place to place as occasion requires.

Dr. Johnson, in his report upon scarlet fever, says: "The construction of disinfecting chambers would not only afford great relief to families whose household goods required purification, but would more completely insure the public safety by the thorough destruction of contagion." ‡

Dry and moist heat are efficient destroyers of infection, and in the strict meaning of the term are true disinfectants. They are especially applicable for the disinfection of clothing and bedding. In the case of old clothing, bedding, rags, especially such as are soiled with the sputa and excreta of those who are sick with infectious diseases, total destruction by fire is desirable, by the use of which method there can be no doubt as to the destruction, not only of the infectious, but also of the infected material.

The following valuable circular of the American Public Health Association, previously referred to, is herewith presented in order that it may have a wide circulation among the local boards of health of the State.

* Revue d'hygiene July, 1885, p. 529.
" " Oct. 1885, p. 828.

† See 9th Report of Massachusetts State Board of Health, 1878, p. 317.

‡ *Ibid.*, p. 321.

DISINFECTION AND DISINFECTANTS.

[PRELIMINARY REPORT MADE BY THE COMMITTEE ON DISINFECTANTS OF THE AMERICAN PUBLIC HEALTH ASSOCIATION.]

The object of *disinfection* is to prevent the extension of infectious diseases by destroying the specific infectious material which gives rise to them. This is accomplished by the use of *disinfectants.*

There can be no partial disinfection of such material; either its infecting power is destroyed or it is not. In the latter case there is a failure to disinfect. Nor can there be any disinfection in the absence of infectious material.

It has been proved for several kinds of infectious material that its specific infecting power is due to the presence of living micro-organisms, known in a general way as "disease germs;" and practical sanitation is now based upon the belief that the infecting agents in all kinds of infectious material are of this nature. Disinfection, therefore, consists essentially in the destruction of disease germs.

Popularly, the term disinfection is used in a much broader sense. Any chemical agent which destroys or masks bad odors, or which arrests putrefactive decomposition, is spoken of as a disinfectant. And in the absence of any infectious disease it is common to speak of disinfecting a foul cesspool, or bad smelling stable, or privy vault.

This popular use of the term has led to much misapprehension, and the agents which have been found to destroy bad odors — *deodorizers* — or to arrest putrefactive decomposition — *antiseptics* — have been confidently recommended and extensively used for the destruction of disease germs in the excreta of patients with cholera, typhoid fever, etc.

The injurious consequences which are likely to result from such misapprehension and misuse of the word disinfectant will be appreciated when it is known that:

Recent researches have demonstrated that many of the agents which have been found useful as deodorizers, or as antiseptics, are entirely without value for the destruction of disease germs.

This is true, for example, as regards the sulphate of iron or copperas, a salt which has been extensively used with the idea that it is a valuable disinfectant. As a matter of fact, sulphate of iron in saturated solution does not destroy the vitality of disease germs or the infecting power of material containing them. This salt is, nevertheless, a very valuable antiseptic, and its low price makes it one of the most available agents for the arrest of putrefactive decomposition in privy vaults, etc.

Antiseptic agents also exercise a restraining influence upon the development of disease germs, and their use during epidemics is to be recommended, when masses of organic material in the vicinity of human habitations cannot be completely destroyed, or removed, or disinfected.

While an antiseptic agent is not necessarily a disinfectant, all disinfectants are antiseptics; for putrefactive decomposition is due to the development of "germs" of the same class as that to which disease germs belong, and the agents which destroy the latter also destroy the bacteria of putrefaction, when brought in contact with them in sufficient quantity, or restrain their development when present in smaller amounts.

A large number of the proprietary "disinfectants," so called, which are in the market, are simply deodorizers or antiseptics, of greater or less value, and are entirely untrustworthy for disinfecting purposes.

Antiseptics are to be used at all times when it is impracticable to remove filth from the vicinity of human habitations, but they are a poor substitute for cleanliness.

During the prevalence of epidemic diseases, such as yellow fever, typhoid fever and cholera, it is better to use, in privy vaults, cesspools, etc., those antiseptics which are also disinfectants, i. e., germicides; and when the contents

of such receptacles are known to be infected this becomes imperative.

Still more important is the destruction at our seaport quarantine stations of infectious material which has its origin outside of the boundaries of the United States, and the destruction, within our boundaries, of infectious material given off from the persons of those attacked with any infectious disease, whether imported or of indigenous origin.

In a sick-room we have disease germs at an advantage, for we know where to find them as well as how to kill them.

Having this knowledge, not to apply it would be criminal negligence, for our efforts to restrict the extension of infectious diseases must depend largely upon the proper use of disinfectants in the sick-room.

General Directions.

Disinfection of Excreta, etc.

The infectious character of the dejections of patients suffering from cholera and from typhoid fever is well established; and this is true of mild cases and of the earliest stages of these diseases as well as of severe and fatal cases. It is probable that epidemic dysentery, tuberculosis, and perhaps diphtheria, yellow fever, scarlet fever and typhus fever may also be transmitted by means of the alvine discharges of the sick. It is therefore of the first importance that these should be disinfected. In cholera, diphtheria, yellow fever and scarlet fever, all vomited material should also be looked upon as infectious. And in tuberculosis, diphtheria, scarlet fever and infectious pneumonia, the sputa of the sick should be disinfected or destroyed by fire. It seems advisable also to treat the urine of patients sick with an infectious disease with one of the disinfecting solutions below recommended.

Chloride of lime, or bleaching powder, is, perhaps, entitled to the first place for disinfecting excreta, on account of the rapidity of its action. The following standard solution is recommended:

STANDARD SOLUTION No. 1. — Dissolve chloride of lime of the best quality* in soft water, in the proportion of four ounces to the gallon. Use one pint of water of this solution for the disinfection of each discharge in cholera, typhoid fever, etc. Mix well and leave in vessel for at least ten minutes before throwing into privy vault or water closet. The same directions apply for the disinfection of vomited matters. Infected sputum should be discharged directly into a cup half full of the solution.

STANDARD SOLUTION No. 2. — Dissolve Corrosive Sublimate and Permanganate of Potash in soft water, in the proportion of two drachms of each salt to the gallon. This is to be used for the same purposes and in the same way as Standard Solution No. 1. It is equally effective, but it is necessary to leave it for a longer time in contact with the material to be disinfected; at least an hour. The only advantage which this solution has over the chloride of lime solution consists in the fact that it is odorless, while the odor of chlorine in the sick-room is considered by some persons objectionable. The cost is about the same.† It must be remembered that this solution is highly poisonous. It is proper, also, to call attention to the fact that *it will injure lead pipes if passed through them in considerable quantities.*

STANDARD SOLUTION No. 3. — To one part of Labarraque's Solution (liquor sodæ chlorinatæ) add five parts of soft water. This solution is more expensive ‡ than the solution of chloride of lime, and has no special advantages for the purposes mentioned. It may, however, be used in the same manner as recommended for Standard Solution No. 1.

* Good chloride of lime should contain at least 25 per cent. of available chlorine. (See preliminary report of committee on disinfectants: "The Medical News," Philadelphia, February 7, 1885, page 147.) It may be purchased by the quantity at five cents per pound. The cost of the standard solution recommended is therefore less than two cents a gallon. A clear solution may be obtained by filtration or by decantation, but the insoluble sediment does no harm, and this is an unnecessary refinement.

† Corrosive sublimate costs about 70 cents a pound, and permanganate of potash 65 cents a pound, by the single pound. This makes the cost of Standard Solution No. 2 a little more than two cents a gallon.

‡ We assume that the solution used will contain at least 3 per cent. of available chlorine, which would give us 0.5 per cent. in the diluted solution. The cost per gallon of the undiluted solution should not be more than fifty cents by the quantity. This would make our standard solution cost between eight and nine cents a gallon.

Disinfection of the Person.

The surface of the body of a sick person, or of his attendants, when soiled with infectious discharges, should be at once cleansed with a suitable disinfecting agent. For this purpose Standard Solution No. 3 may be used.

In diseases like small-pox and scarlet fever, in which the infectious agent is given off from the entire surface of the body, occasional ablutions with Labarraque's Solution, diluted with twenty parts of water, will be more suitable than the stronger solution above recommended.

In all infectious diseases the surface of the body of the dead should be thoroughly washed with one of the standard solutions above recommended, and then enveloped in a sheet saturated with the same.

Disinfection of Clothing.

Boiling for half an hour will destroy the vitality of all known disease germs, and there is no better way of disinfecting clothing or bedding which can be washed than to put it through the ordinary operations of the laundry. No delay should occur, however, between the time of removing soiled clothing from the person or bed of the sick and its immersion in boiling water, or in one of the following solutions; and no article should be permitted to leave the infected room until so treated.

STANDARD SOLUTION NO. 4. — Dissolve corrosive sublimate in water * in the proportion of four ounces to the gallon, and add one drachm of permanganate of potash to each gallon to give color to the solution. One fluid ounce of this standard solution to the gallon of water will make a suitable solution for the disinfection of clothing. The articles to be disinfected must be thoroughly soaked with the disinfecting solution and left in it for at least two hours, after which they may be wrung and sent to the wash.†

N. B. *Solutions of corrosive sublimate should not be placed in metal receptacles*, for the salt is decomposed and the mercury precipitated by contact with copper, lead or tin. A wooden tub or earthen crock is a suitable receptacle for such solutions.

* Mercuric chloride (corrosive sublimate) is soluble in cold water in the proportion of one part in sixteen. Solution is greatly facilitated by heat.

† Before using this solution for disinfecting clothing, decolorize it by adding to it a little Labarraque's solution or chloride of lime.

Clothing may also be disinfected by immersion for two hours in a solution made by diluting Standard Solution No. 1 with nine parts of water — one gallon in ten. This solution is preferable for general use, especially during the prevalence of epidemics, on account of the possibility of accidents from the poisonous nature of Standard Solution No. 4. When diluted as directed this solution may, however, be used without danger from poisoning through the medium of clothing immersed in it, or by absorption through the hands in washing. A poisonous dose could scarcely be swallowed by mistake, owing to the metallic taste of the solution, and the considerable quantity which would be required to produce a fatal effect — at least half a pint.

Clothing and bedding which cannot be washed may be disinfected by exposure to dry heat in a properly constructed disinfecting chamber for three or four hours. A temperature of 230° Fahr. should be maintained during this time, and the clothing must be freely exposed, *i. e.*, not folded or arranged in piles or bundles, for the penetrating power of dry heat is very slight.

The limitations with reference to the use of dry heat as a disinfectant are stated in a "Parliamentary Report of the Committee on Disinfectants," published in "The Medical News," Philadelphia, March 14, 1885.

The temperature above mentioned will not destroy the *spores* of bacilli — e. g., of the anthrax bacillus — but is effective for the destruction of all disease germs which do not form spores; and there is good reason to believe that this list includes small-pox, cholera, yellow fever, diphtheria, erysipelas, puerperal fever and scarlet fever. (?) Moist heat is far more effective, and it is demonstrated that ten minutes exposure to steam, at a temperature of 230° Fahr., will destroy all known disease germs, including the most refractory spores.

In the absence of a suitable disinfecting chamber, it will be necessary to burn infected clothing and bedding, the value of which would be destroyed by immersion in boiling water, or in one of the disinfecting solutions recommended.

Disinfection of the Sick Room.

In the sick-room no disinfectant can take the place of free ventilation and cleanliness. It is an axiom in sanitary science that it is impracticable to disinfect an occupied apartment; for the reason that disease germs are not destroyed by the presence in the atmosphere of any known disinfectant in respirable quantity. Bad odors may be neutralized, but this does not constitute disinfection in the sense in which the term is here used. These bad odors are, for the most part, an indication of want of cleanliness, or of proper ventilation; and it is better to turn contaminated air out of the window, or up the chimney, than to attempt to purify it by the use of volatile chemical agents, such as carbolic acid, chlorine, etc., which are all more or less offensive to the sick, and are useless so far as disinfection — properly so-called — is concerned.

When an apartment which has been occupied by a person sick with an infectious disease is vacated, it should be disinfected. But it is hardly worth while to attempt to disinfect the atmosphere of such an apartment, for this will escape through an open window and be replaced by fresh air from without, while preparations are being made to disinfect it. Moreover, experience shows that the infecting power of such an atmosphere is quickly lost by dilution, or by the destruction of floating disease germs through contact with oxygen, and that even small-pox and scarlet fever are not transmitted to any great distance through the atmosphere; while cholera, typhoid fever, and yellow fever, are rarely, if ever, contracted by contact with the sick, or by respiring the atmosphere of the apartments occupied by them.

The object of disinfection in the sick-room is, mainly, the destruction of infectious material attached to surfaces, or deposited as dust upon window-ledges, in crevices, etc. If the room has been properly cleansed and ventilated while still occupied by the sick person, and especially if it was stripped of carpets and unnecessary furniture at the outset of his attack, the difficulties of disinfection will be greatly reduced.

All surfaces should be thoroughly washed with a solution of corrosive sublimate, of the strength of one part in 1,000

parts of water, which may be conveniently made by adding four ounces of Standard Solution No. 4 to the gallon, or one pint to four gallons of water.* The walls and ceiling, if plastered, should be brushed over with this solution, after which they should be whitewashed with a lime wash. Especial care must be taken to wash away all dust from window-ledges and other places where it may have settled, and to thoroughly cleanse crevices and out-of-the-way places. After this application of the disinfecting solution, and an interval of twenty-four hours or longer for free ventilation, the floors and woodwork should be well scrubbed with soap and hot water, and this should be followed by a second more prolonged exposure to fresh air, admitted through open doors and windows.

Many sanitary authorities consider it necessary to insist upon fumigation with sulphurous acid gas — produced by combustion of sulphur — for the disinfection of the sick-room. As an additional precaution this is to be recommended, especially for rooms which have been occupied by patients with small-pox, scarlet fever, diphtheria, typhus fever and yellow fever. It should precede the washing of surfaces and free ventilation above recommended. But fumigation with sulphurous acid gas alone, as commonly practised, cannot be relied upon for the disinfection of the sick-room and its contents, including bedding, furniture, infected clothing, etc., as is popularly believed. And a misplaced confidence in this mode of disinfection is likely to lead to a neglect of the more important measures which have been recommended. In the absence of moisture the disinfecting power of sulphurous acid gas is very limited, and under no circumstances can it be relied upon for the destruction of spores.† But exposure to this agent in sufficient quantity, and for a considerable time, especially in the presence of moisture, is destructive of disease germs, in the absence of spores. It is essential, however, that the germs to be destroyed shall be very freely exposed to the disinfecting agent, which has but slight penetrating power.

* Decolorise before using by adding a little Labarraque's solution or chloride of lime.

† See Preliminary Report of Committee on Disinfectants in "The Medical News" of March 28, 1885.

To secure any results of value it will be necessary to close the apartment to be disinfected as completely as possible, by stopping all apertures through which the gas might escape, and to burn not less than three pounds of sulphur for each thousand cubic feet of air-space in the room.* To secure complete combustion of the sulphur it should be placed, in powder or in small fragments, in a shallow iron pan, which should be set upon a couple of bricks in a tub partly filled with water, to guard against fire. The sulphur should be thoroughly moistened with alcohol before igniting it.

Disinfection of Privy Vaults, Cesspools, etc.

When the excreta — not previously disinfected — of patients with cholera or typhoid fever have been thrown into a privy vault, this is infected, and disinfection should be resorted to as soon as the fact is discovered, or whenever there is reasonable suspicion that such is the case. It will be advisable to take the same precautions with reference to privy vaults into which the excreta of yellow-fever patients have been thrown, although we do not definitely know that this is infectious material. Disinfection may be accomplished either with corrosive sublimate or with chloride of lime. The amount used must be proportioned to the amount of material to be disinfected.

Use one pound of corrosive sublimate for every five hundred pounds (estimated) of fecal matter contained in the vault, or one pound of chloride of lime to every thirty pounds.

Standard Solution No. 4, diluted with three parts of water, may be used. It should be applied — the diluted solution — in the proportion of one gallon to every four gallons (estimated) of the contents of the vault.

If chloride of lime is to be used, one gallon of Standard Solution No. 1 will be required for every gallon (estimated) of the material to be disinfected.

All exposed portions of the vault, and the woodwork above it, should be thoroughly washed down with the disinfecting solution.

* One litre of sulphur dioxide weighs 2.9 grammes. To obtain ten litres of gas, it is necessary to burn completely fifteen grammes of "flowersof sulphur" (Vallin)

To keep a privy vault disinfected during the progress of an epidemic, sprinkle chloride of lime freely over the surface of its contents daily. Or, if the odor of chlorine is objectionable, apply daily four or five gallons of Standard Solution No. 2, which should be made up by the barrel, and kept in a convenient location for this purpose.

Disinfection of Ingesta.

It is well established that cholera and typhoid fever are very frequently, and perhaps usually, transmitted through the medium of infected water or articles of food, and especially milk. Fortunately we have a simple means at hand for disinfecting such infected fluids. This consists in the application of heat. The boiling temperature maintained for half an hour kills all known disease germs. So far as the germs of cholera, yellow fever and diphtheria are concerned, there is good reason to believe that a temperature considerably below the boiling point of water will destroy them. But in order to keep on the safe side it is best not to trust anything short of the boiling point (212° F.) when the object is to disinfect food or drink which is open to the suspicion of containing the germs of any infectious disease.

During the prevalence of an epidemic of cholera, it is well to boil all water for drinking purposes. After boiling, the water may be filtered, if necessary to remove sediment, and then cooled with *pure* ice if desired.

A sheet of filtering paper, such as druggists use, and a glass or tin funnel, furnishes the best means for filtering water on a small scale for drinking purposes. A fresh sheet of paper is to be used each day.

[The above "Preliminary Report" has been prepared at the request of the Sanitary Council of the Mississippi Valley, as expressed in the following resolution adopted at its recent meeting in the city of New Orleans (March 10-11, 1885).

"Resolved, That the Secretary request from the Chairman of the Committee on Disinfectants, appointed at the last meeting of the American Public Health Association, a plain, practical paper on Disinfection and Disinfectants, for popular use and distribution, to be furnished to the Chairman of the Special Committee of this Council on General Sanitation."

GEORGE M. STERNBERG, Major and Surgeon U. S. A.
Chairman Committee on Disinfectants.]

SANITARY RELATIONS OF TAUNTON.

By E. U. Jones, M. D.

MAP OF A PORTION OF TAUNTON.

SANITARY RELATIONS OF TAUNTON.

By E U. Jones, M. D.

The city of Taunton lies in the valley of Taunton River, and in that of its tributary, Mill River. These valleys have a general trend of N.N.E. to S.S.W., with secondary valleys to the southward and eastward. In none of the thickly settled portion of the city does the ground lie more than fifty feet above the sea level, and in consequence of this condition, the current of the river is sluggish, and an average tide of more than two feet occurs. The subsoil is clay, at depths varying from six inches to more than fifteen feet below the overlying soil, and has long been famed for its excellence in the manufacture of bricks. This substratum of clay is not evenly disposed, but is marked with elevations and deep, valley-like depressions, which are filled with sand and sandy loam. The general trend of these depressions is toward the rivers, and they form a portion of the surface drainage of the city; but oftentimes they are disposed into basin-like hollows, which retain the surface water, to be relieved only by slow percolation or evaporation. Everywhere are found quicksands, sometimes with a superstratum of clay, in the most unexpected places, and of unmeasured depth. They have seriously interfered, at times, with the laying of sewers, with the digging or driving of wells, and with the foundations of dwellings. This general condition of things, underlying the most thickly settled portions of our city, demands to be taken into account in studying the sanitary relations of Taunton.

The city proper lies to the west of Taunton River, stretching northerly nearly four miles, and through the centre of its most populous and active business portions runs Mill

River. This stream is the outlet of Scadding's Pond, or rather a series of ponds lying in Norton, Easton and the southern part of Sharon. All the "mill privileges" within the limits of the city proper lie upon this stream, there being six dams within a little more than two miles. It is the natural drainage of a large territory, and its fall from Scadding's Pond to Taunton River is at the rate of sixteen feet to the mile. This stream also forms the natural level of sewerage of the greater portion of the city, and all of the sewers which normally could be turned that way have been emptied into it open-mouthed. Thus it has become the trunk sewer of the city, and this notwithstanding that there is a dam below the section into which all these sewers enter. Practically, the whole sewage of the central portion of the city is not allowed to enter Taunton River, but is confined in the bed of this stream, just where it can do the greatest harm, and in the centre of the densest population. The stench is particularly perceptible in crossing the bridges, and forcibly calls for a change. The wastes of the mills situated upon the banks of the river, undoubtedly add their quotas to the composition of the ill odors; but, so far as observed, add nothing that is detrimental to health. The stream is exceedingly tortuous, and its bed is filled with rocks; and every natural obstruction seems to be so placed as to retain the filth, and allow it to decompose under the summer suns. The river is often flushed by the quantity of water let down from above, but this flushing is by no means regular, and in the summer season, especially from June to October, the flushings are very seldom, and the current of the river between the last two dams is feeble, and narrowed to a few feet. It seems as if every condition was the most favorable to the causation of so great an amount of sickness as to arouse the population to a determined effort to remedy the evil. That it does not cause more sickness, is perhaps ascribable to two facts,— the dwellings upon the banks are comparatively few, and those mostly of tenement houses, whose population is largely in the open air, and the manufactories and works which are situated upon its borders are well ventilated and never overheated. For more than thirty years this stream has been thus contaminated, but it

has only been within the last ten or fifteen years, at the most, that the contamination has called for thought; and now, within five years, the matter has become one for very serious consideration. Within the next five years, the city must take efficient action, or suffer the most serious consequences in an increased death-rate. Should the cholera enter this country, the banks of this river would be the scene of its devastations, and its ravages would be many fold more than in 1854. The bed and sides of the river have for their basins the same clay that has been spoken of, perfectly impermeable to the ordinary infiltration of water, and, as every sanitarian knows, perfectly useless for the disinfection of sewage.

This sewage is now very different from what it was eight years since; for then but comparatively few sewers existed, and their discharge was only of the natural overflow of cesspools and house water. Mill River could care for that without much trouble. But in 1876 our water works were established, an enormous quantity of water began to be used, increased sewerage was imperatively demanded, water closets were placed in the houses and connected with the sewers; and a vast amount of human excreta from hotels, dwellings, work-rooms and manufactories, etc., besides an enormous increase in the amount of normal house sewage, gives to Mill River an amount of disinfecting work to do with which it is utterly unable to cope.

That this will be remedied within the next five years we have a faith which amounts almost to a certainty.

No system of sewerage has ever been adopted by the city of Taunton, and, as a consequence, most of its present sewers will have to be relaid whenever a system is decided upon. Difficulties from this cause are already arising, and many portions of the city which have increased their population of late, and which imperatively need sewerage, cannot be connected with the sewers already laid. The city will soon be obliged to face this matter, and, commencing with Mill River, place every other sewer in relation with it. Difficult as the problem seems to be, it can be met successfully and the mortality tables greatly reduced.

The results of proper sewerage in Taunton will not be

confined to the elimination of the evils of excrementitious products alone, but the trenches in which the sewers will be laid will also constitute a valuable means of disposing of the surface water, now held by the clay, the sand valleys and the quicksand pits before referred to. A large territory in the immediate vicinity of the central portion of the city, not now sanitarily fit for building lots, would become valuable and indeed choice locations, and the money invested in sewers would be returned in the increased wealth of the city.

A public water supply was introduced in 1877, previous to which time the only dependence of the inhabitants was upon the ordinary wells. Owing to the clay subsoil, the greater part of these wells were shallow, and the water obtained only surface water, no springs having been reached. In the older portions of the town, settled for more than two hundred years, the water was particularly bad, and was undoubtedly the cause of a great deal of sickness. After the introduction of tubular wells, many of these old wells were deserted, and the new wells sunken so deeply that pure water was obtained. But it was necessary to drive some of them fifty feet, reaching completely through the clay to a substratum of gravel, but with the reward of finding pure and plentiful water. A large proportion of the water still used in the city comes from both kinds of these wells, some of which have been condemned by the board of health and city water substituted. It has been thought that some of the cases of typhoid fever — sporadic cases (as we have had, recently, no true epidemics of the disease) — have had their origin in the drinking of these waters. Perhaps such allegation has not been sufficiently proven, and the cases are therefore not considered worthy of report. Certain it is, however, that since the introduction of the public water supply, there have been no epidemics of typhoid, but seven deaths having been returned from that cause in 1884, four of which occurred in the month of November.

The public water supply is taken from the Taunton River, an analysis of whose water showed it to be of exceeding purity. A filter bed was prepared by the side of the river, into which the water was received; but it was found that the

bed received, through its base and sides, water from many springs, and, for the first years, the "city water" was the boast of the people. As its use increased, it was found that the supply was not equal to the demand, and the facilities were largely increased by extending a conduit a long distance by the side of the river, ending in a simple but thoroughly built filter. The water which is thus received is perfectly pure and good, so far as danger to health is concerned, but is colored slightly, many miles distant, by vegetable infusions.

An analysis of the water by Prof. Wood for July, 1885, is : —

	Free Am.	Album. Am.	Chlor.	Total Residue.	Hardness.
Low water, ...	0.0044	0.0150	0.60	8 00	1
High water, ...	0.0164	0.0312	0.60	9.00	1½

The albuminoids were determined to be wholly of vegetable origin.

The average daily consumption of water is about 650,000 gallons, the maximum being 1,000,000 gallons, giving about 27 gallons daily to each inhabitant, 37 gallons to each consumer, and 347 gallons to each service, sent through 48 miles of main pipe and about 22 miles of service pipe. Were this large amount of water carried off through well-appointed sewers, it would aid in lessening the insanitary conditions of Mill River; but as many of the water takers have no connection with the sewers, but depend upon cesspools, and those cesspools leaching ones, the ground in their vicinage becomes more saturated with water than formerly, and there is more complaint of damp and unhealthy cellars. The free use of water upon the gardens and lawns also tends to increase this evil, and, as the water is commonly thus used in the evening, the tendency is to surround the houses with increased dampness. These evils are more apparent than in other cities, perhaps because of the imper-

meability of the subsoil and its nearness to the surface in many locations.

Under the old system of pumping, the labor and slowness of getting the water restricted the amount used, both in doors and out, and no more was put upon the ground than would be taken by the growing vegetation, nor was the air around the dwellings loaded with an abnormal moisture. In being relieved of one evil another has thus manifested itself, though by no means so great a one.

Previous to 1883, the sanitary care of the city had been under a committee of health, formed by three members of the city council. This committee received such complaints as were brought to its notice, and remedied the evils to the best of its knowledge. The police aided it in any investigations which it was called upon to make, reported such cases as had become nuisances, when observed in their rounds, and at least once a year one of their number made a special visit to those sections of the city in which insanitary conditions were most likely to be found. And this duty was as faithfully performed as it could be with their limited powers and the multiplicity of other and more specific duties.

The act of the legislature of 1882, revising the charter of the city of Taunton, having been accepted, it was found necessary that section 9 of that charter should be amended, with relation to the election of city physician, before section 14, providing for the appointment of a board of health, could be complied with. An act making the needed amendment passed the legislature, and was approved March 14, 1883. Immediately following the approval of the act, the mayor appointed and the board of aldermen confirmed the following gentlemen as the board of health for the year: —

E. U. Jones, M. D., for two years, and as chairman.

Gamaliel Lane, for one year.

F. D. Tripp, M. D., for city physician, and *ex officio* member of the board.

The first session of the board was held March 22, and was devoted to organization, and the marking out of a "central district," consisting of the most thickly settled portions of the city lying on either side of Mill River. Within this district it was decided to gather the ashes, house dirt and swill,

in a responsible and regular manner, and to pay especial attention to cleanliness of premises. Much of this portion of the city had, in former days, been wet and marshy, owing to the nature of the soil, as before stated, and particular care was needed as to its sanitary condition. This was ably attended to, and before the end of the year many improvements had been made. Many of the subsequent sessions of the board were employed in codifying and getting before the people their rules and regulations, and in obtaining an understanding of the board's own duties, powers and rights. In May a contract was entered into for the removal of the ashes, house-refuse and swill within this district, and this contract involved the question of the right of the inhabitants to keep swine. The orders of the board for the removal of the swine were earnestly resisted, and a decision adverse to the board, upon a technicality, rendered the work harder ; but the action of the board has been quietly but persistently enforced, and now there is no occasion for complaint. And the city of Taunton may well be proud of the cleanliness of this central district, in which formerly prevailed many mal-odorous combinations. As a proof of this, before the close of the year, petitions were received for the extension of this district, so that others could "enjoy the same blessings."

The method in vogue for the removal of night soil and cesspool matters is to engage one or other of certain men, — farmers who have wagons made for the purpose, — to call in the night and do the work. The substances thus obtained are utilized by the farmers, and are received as part payment for the work done. In this operation there are three interests to be served, — those of the landlord, tenant and farmer, — and all these are to be governed to a certain extent by the weather, and the character of the other work on hand by the farmer. It is frequently a long time before all these interests can be made to meet, and in the meantime the inmates of the unclean premises, and the whole neighborhood, remain exposed to the filthy and unhealthy condition. It is difficult for the board to remedy this, for, while it has authority over the condition, the control of the third interest is not so easily reached. The landlord or tenant may mean well enough, but he is dependent upon the promises of the night-soil man.

To work in the most efficient manner it will be necessary to have direct control over all the interests involved, so that, with the order to have the vault or cesspool cleaned, an order can also be given to a responsible person to do it at a certain time. A work so important should not be done at arm's length.*

Like all old towns, Taunton's privy vaults and cesspools have been of the most primitive order. Nearly all of the older vaults are built of stone loosely packed together, allowing the leaching of all the liquid matters. The deposits are open to the influence of sun and storm, the first of which dessicates, and the second washes the finer portions thus prepared into the earth; to mingle with the waters of the wells, and to prepare the way for disease. The cesspools are of the same construction, and under this system neither vault nor cesspool are frequently cleaned. But the ground is filled with impure matters, the wells and springs suffer, and disease is conveyed in "mysterious" ways from neighbor to neighbor. This condition of things led to the prompt adoption of regulation 6, similar to that in use in other cities. "The vault of every privy or cesspool shall be so constructed as to be conveniently approached, opened and cleaned, and shall be so tight that the contents cannot escape therefrom." The board became aware of the magnitude of the work it had undertaken, but its record for the few remaining months of the year is: —

Privy vaults cleaned under direction, ...	142
Cesspools " " " . . about	50
Foul cellars " " "	18
Yards made filthy by overflowing sink drains, etc.,	136
Pig pens removed, ...	24
Sink drains running into street, ...	11
Privy vaults ordered to be built or repaired, ...	23
Requested to enter sewers, ...	7

Besides these examinations, more than two hundred tenement houses in East Taunton, Whittenton and the Weir, have been thoroughly examined, and a word of advice or caution given where it was needed.

* This year, 1885, six persons have been licensed to do this work to the exclusion of all others.

It seems as though some good had been done by this work, for the

Number of deaths in	1881 was	464
" "	1882 was	445
" "	1883 was	392

with an increasing population.

1884.

In February the membership of the board was changed, Wm. Macfarlane taking the place of Mr. Lane; and in August Dr. Edward F. Galligan was appointed city physician, in place of Dr. F. D. Tripp, deceased. The board consisted of Dr. E. U. Jones, Wm. Macfarlane and Dr. E. F. Galligan.

The education which the public received in sanitary matters during the last year became very evident this year, for from every side complaints and requests for advice in sanitary needs became frequent, and there have been no idle moments to the active members of the board. Every portion of the city has been visited and thoroughly inspected several times during the season, and certain portions, more closely inhabited, have been inspected every month.

The contracts for the removal of the ashes and swill which had been entered into last year proved unsatisfactory both to the board and the contractors, and May 21 the contract for the removal of the ashes and house dirt was annulled, and the matter taken under the immediate direction of the board. The result so far has been exceedingly satisfactory to the board and the public, and the area served has been obliged to be extended. In October the contract for the removal of the swill and offal was also annulled, and this work was undertaken by the overseers of the poor, and the swill is collected by them and utilized upon the city farm. The work is now thoroughly and well done, and the public interests are well subserved.

During the year there have been cleaned under the direct order of the board: —

Privy vaults,	140
Cesspools,	131
Yards made filthy by overflowing cesspools, drains, etc.,	15

Foul cellars,	12
Stagnant ponds,	3
Pig pens removed or conditioned,	24
Privies, vaults or cesspools ordered built or repaired,	47
Various insanitary conditions,	104
Ordered to enter sewers,	5
Families ordered supplied with city water,	30
Traps ordered in houses,	89

This year has been rather noted for the prevalence of zymotic diseases of an epidemic character. The same sections of the city have been scourged by them in turn, while other sections have entirely escaped, or been but slightly visited.

The measles has visited nearly every school and section, and it seems as though the epidemic must cease for the lack of material. It caused but three deaths, and the diagnosis of one of these, an infant dying without medical attendance, was doubtful. A large number of the cases had only domestic treatment.

But three cases of diphtheria were reported previous to May 1, when several children in Second Avenue, Whittenton, were found sick with it, one of whom died. This was the beginning of the epidemic in that region, *and which seemed to alternate with scarlet fever*. No origin could be assigned for it, and it was not particularly fatal. But an epidemic occurred June 24, at 40 Park Street, which was followed by more serious consequences. For several weeks it was confined mostly to Park Street, but soon spread in the line of Adams Street to the corner of Grove, thence down Grove to Washington. In these two streets scarcely a house escaped either pronounced diphtheria or some form of sore throat. Every house in which the disease occurred was visited again and again, to discover if any local conditions could be the cause, but none were found. Later in the season the disease resumed its progress up Adams Street, and, from its junction with Broadway, spread up and down both sides of Broadway. It never really crossed this street, though two cases were reported on Randall Street. A study of the annexed map, * in connection with these remarks, will not

* Page 356.

fail to show the fact that, no local cause being found, no other cause can be assigned for the action of this epidemic but the low coves of the river, which receive all of the drainage of these streets, the overflows of privy vaults and cesspools, and, worse than all, the contents of the Adams Street sewer, whose outlet is seldom covered with water. For a large part of the season, especially at times of low ground-water level, these coves are entirely uncovered, and may manifest all of the insalubrities of a swamp.

Early in September the westerly side of Scadding's Pond received the disease, and a close examination showed that nearly every family sending children to the school had been affected. Accordingly the school was closed by order of the board.

The total number of deaths was more than one-tenth of the whole number for the year, and more than fifty per cent. of the deaths from all the acute zymotic diseases, including those from scarlet fever, typhoid fever, cerebro-spinal meningitis, cholera infantum, etc. This enormous percentage falls most heavily upon the laboring classes.

Scarlet fever has lingered among us for several years, a single sporadic case appearing now and then without apparent cause or result. They neither seemed to receive nor communicate the disease, and no particular action was taken with regard to them. But it broke out in a malignant form, April 15, in a house on Grosvenor Street. The house was immediately isolated, and cards posted upon the house and at the entrance of the court leading to it. The house was in a bad sanitary condition and orders were given for its immediate cleansing. Two of the children died. On the 25th a case was reported on West Britannia Street, possibly having connection with the cases on Grosvenor Street. This case is of interest, as it is thought that the spread of the disease in Whittenton village and Bay Street was due to infection from it, and from those who had attended the child. *The disease, in its spread, took precisely the same lines as the diphtheria, sometimes following it and sometimes preceding.* Though widely spread, this epidemic appears to have been mild, but four deaths having been caused by it. It may have been modified by the presence of the diphtheria.

The total number of deaths, exclusive of those at the State Lunatic Asylum and those certified by the medical examiner, during this year, was 396.

Of these pneumonic diseases constituted a little more than one-fifth.

Consumption,	62
Pneumonia,	11
Bronchitis,	8
Pleuro-pneumonia,	2
Congestion (pneumonic),	2

Of zymotic diseases a little less than one-third.

Cholera infantum and diarrhœa,	33
Diphtheria,	43
Dysentery,	2
Erysipelas,	2
Marasmus,	13
Measles,	3
Meningitis,	7
Peritonitis,	5
Pyemia,	2
Scarlatina,	3
Typhoid fever,	7

Other diseases, 191; of which were, —

"Heart disease,"	24
Bright's disease,	11
Convulsions,	15
Croup,	10
Paralysis,	14
Senile asthenia,	23
Still born,	17
Various diseases not grouped,	77
	396

The ratio of deaths to population is 16.74 per cent., which is by no means a bad showing for the year. Indeed, Taunton must be reckoned as a healthy city; but, barring fatal epidemics, the per cent. of deaths from zymotic diseases can be reduced.

Climatic Conditions for 1884.

Monthly Means of Tri-daily Observations.

	Prevailing Winds.	Barometer Corrected.	Thermometer.			Precipitation. Inches.	Ozone. Scale 1 to 10.
			Max.	Min.	Mean.		
January, . . .	N. E. E.	30.143	51°	-3°	24.6°	4.35	1.67
February, . . .	N. E.	30.085	54°	3°	36.3°	4.84	3.89
March, . . .	N. N. E.	30.017	65°	4°	35.3°	5.33	3.55
April, ...	N. E.	29.819	71°	26°	45.1°	4.12	2.50
May, ...	E.	29.953	85°	31°	55.7°	2.73	3.81
June, ...	E. W.	30.114	95°	34°	65°	4.04	2.80*
July, ...	W.	29.852	86°	50°	68°	4.13	3.77
August, . . .	E. W.	30.072	93°	50°	68.6°	5.42	4.48
September, . . .	S. W.	30.085	97°	37°	65.6°	0.53	2.10
October, . . .	E. W.	30.121	86°	26°	52.8°	2.55	1.71
November, . . .	W.	30.087	65°	18°	41.3°	3.63	1.97
December, . . .	W.	30.139	63°	-10°	34.0°	5.31	2.64
Means and Totals, .		30.040	75.9°	22°	49.36°	46.98	

* Partial observations.

For the first five months of the year the ozone was greatly in excess during the daytime; for the remaining seven months the excess seemed equally great during the night. The results given are the daily means for each month.

HEALTH OF TOWNS.

HEALTH OF TOWNS.

The information herewith given is contributed entirely by the local health boards of cities and towns. It is desirable that the State Board should be informed of the condition of towns as to matters pertaining to public health, and for this purpose a circular was issued in July, 1885, requesting information as to the following topics : —

1. Work of local boards. Modes of dealing with noxious and offensive trades.
2. Public water supplies and their pollution, and danger from the same, with means taken for its prevention.
3. Drainage and sewerage and the disposal of sewage.
4. Measures taken for the control of infectious diseases. Enforcement of statutes relating to vaccination of school children.
5. Adulteration of food.
6. Enforcement of the statutes of 1884 relative to the reporting and recording of contagious diseases.
7. Reports on the prevalence of infectious diseases.

To this circular replies were received from 140 cities and towns, containing answers to one or more of the inquiries in the circular.

One fact is prominently manifest, and assumes special importance at the present time, in view of the existence of a serious epidemic of small-pox at Montreal, and that is, the indifference which many towns manifest to the importance of vaccination and the necessity of a thorough enforcement of the statutes relative to the subject. Of the cities and towns who have replied to the circular, 57 report that these statutes are enforced, 7 report that they are not strictly en-

forced, 33 report that they are not enforced, and 43 do not answer the question.

There can, however, be no more convincing proof of the importance of the subject than the fact that a majority of the deaths from small-pox in Montreal, in the present epidemic, have been among the *unvaccinated children*.

It is indeed an appalling fact that parents, often protected by vaccination themselves, should neglect to afford the same protection for their own offspring. The statistics upon this point, already cited, from the 11th Local Government Board Report of England,* afford overwhelming proof of the value of the measure.

An earlier inquiry also elicited the following figures relative to the health boards of cities and towns. Among 309 cities and towns from which replies were received, 175 had no independent board of health, the selectmen acting as such.

In 132 there were local boards of health, acting as a separate body from the selectmen or the mayor and aldermen.

In 2 towns the selectmen appointed a physician as an agent or health officer.

There can be no doubt that the sanitary interests of the State would be served in a far better manner by the appointment, at least in all the larger towns, of boards having special fitness for the position.

[The populations given are those of the Census of 1880.]

ALFORD. (Pop. 348.) No measures adopted with reference to infectious diseases.

AUBURN. (Pop. 1,317.) One case of diphtheria and 5 of scarlet fever reported to local board. Eight deaths from consumption. No measures adopted for control of contagious diseases. The writer is decidedly opposed to the use of gluten meal, cotton-seed meal and poor ensilage, for the feed of milch cows whose milk is intended for the use of infants.

AMESBURY. (Pop. 3,355.) One case of diphtheria and 26 of scarlet fever reported to the local board. Diarrhœal diseases, typhoid fever, lung fever and rheumatism were prevalent; and erysipelas and consumption unusually prevalent.

ARLINGTON. (Pop. 4,100.) Two cases of scarlet fever reported to the local board. Scarlet fever, diphtheria, influenza, consumption, diarrhœal diseases, whooping cough, rheumatism were prevalent; measles and lung fever were unusually prevalent.

* Page 238 of this report.

One case of slaughtering establishment attended to and the business discontinued; one of night soil remedied and made inoffensive. The public water supply seems to be in danger of pollution. Each dwelling has a cesspool, and the sewage is removed by inodorous tanks and used upon gardens.

Ashfield. (Pop. 1,066.) Reports measles and influenza very prevalent, while erysipelas, consumption, diarrhœal diseases, whooping cough, lung fever and rheumatism were slightly so for the year ending Dec. 31, 1884.

Andover. (Pop. 5,169.) The work, so far, has been confined to a general inspection of the town, requiring owners of property to improve the sanitary condition of premises where we judge it to be necessary. Considerable improvement has been already effected, but the absence of sewers and water supply makes a perfect compliance with the laws of hygiene impossible.

Ashby. (Pop. 914.) No cases of small-pox, diphtheria and scarlet fever reported to the local board.

Scarlet fever, diphtheria, measles, erysipelas, consumption, diarrhœal diseases, typhoid fever, whooping cough, lung fever and rheumatism were prevalent.

Belchertown. (Pop. 2,346.) No cases of infectious diseases reported to the board. Measles prevalent and pneumonia very prevalent during the year.

Belmont. (Pop. 1,615.) Chapter 98, Acts of 1884, is enforced.

One case of scarlet fever reported to the local board.

Whooping cough and measles unusually prevalent.

Scarlet fever, influenza, consumption, diarrhœal diseases and rheumatism were prevalent.

The local board of health caused one case of keeping swine to be abated.

Bernardston. (Pop. 934.) Measles quite prevalent in the month of April last; no deaths. One case of scarlet fever reported.

Beverly. (Pop. 8,456.) Chapter 98, Acts of 1884, is as yet not enforced.

Diphtheria, consumption, diarrhœal diseases and whooping cough were prevalent. The source of water supply is Wenham Lake. There is no system of sewerage, and with the large amount of water used it is very difficult to dispose of it, but it is emptied into the sea finally. The board has adopted very stringent measures in regard to infectious diseases.

Blackstone. (Pop. 4,907.) Chapter 98, Acts 1884, is complied with: 58 cases of scarlet fever reported. Scarlet fever and measles quite prevalent.

Bolton. (Pop. 903.) Five cases of scarlet fever reported to the local board. Scarlet fever, influenza, typhoid fever and whooping cough prevalent.

Boston. (Pop. 362,839.) Cases reported to the board of health for the year ending Dec. 31, 1884, were: scarlet fever, 2,526; diphtheria, 1,212; and small-pox, one. The reported deaths were: consumption, 1,543; diarrhœal diseases, including cholera infantum, 855; lung fever, 764; diphtheria, 345; typhoid fever, 216; scarlet fever, 209; whooping cough, 181; erysipelas, 47; rheumatism, 26; measles, 13; small-pox and influenza, each, one.

Total deaths in 1884, 9,622; making an estimated death-rate of 22.48 per 1,000. Judged by the number of deaths from preventible causes the city's sanitary condition is gratifying. The total number of deaths from such causes was 2,278, a reduction of 273 from that of the previous year from similar causes. There was but one death from small-pox, and that an unvaccinated person. Diphtheria was the most fatal zymotic disease. The mortality of children under 5, an excellent test of local sanitary condition, was less than that of 1883, the average for the last 10 years being 39.58 per cent. of the total mortality, while that of 1884 was 37.10.

Fears relative to the approach of Asiatic cholera, together with the notoriety given by the press to the most insalubrious parts of the city, served the purpose of strengthening our arms and rendering the task of securing cleanliness where filth abounded a comparatively easy one.

Three forces are enumerated for the prevention of cholera: 1. The city to be put in a good sanitary condition. 2. Prevent introduction of disease by quarantine. 3. In case of introduction of the disease, prompt and efficient isolation, disinfection and cleansing of every person, thing and spot, in whom or in which there may be reason to suspect the presence of infection.

Total number of sanitary inspectors employed is 15. Among the nuisances abated or remedied were 3,920 house drains, 2,909 vaults, 1,008 yards, 1,151 water closets, 1,024 cellars and 411 cesspools: 274 houses were ordered to be vacated, of which 27 were vacated, the remainder being put in proper condition before the expiration of time specified in the notice.

Eight prosecutions were made for violation of the laws and regulations pertaining to public health.

The work of disinfection as conducted by the board embraces the employment of six men and three horses. The disinfectants used are bichloride of mercury, chloride of lime and sulphurous acid gas. The substitution of the former for the sulphate of iron has effected a decrease in cost of material, provided a more efficient disinfectant, and a saving of labor: 725 places, including 3,050 rooms, were disinfected on account of the prevalence of diphtheria, scarlet fever, typhoid fever and measles; 69,768 other places were disinfected as a part of the sanitary work of the board; 175 school-houses were inspected, of which number 143 were found in good condition. In connection with the sanitary condition of the school-houses, the use of the old style of privy vaults, requiring the storage of fecal matter, is condemned.

The need of hospital accommodations for the treatment of infectious diseases is strongly urged by the board.

For the purpose of disposing of refuse material, of which a large city has an immense quantity, a very efficient dumping boat was employed during the year, capable of carrying about 500 tons. It can go to sea with safety even in heavy weather, requires but two men, who can dump

the load, wash out, close the hull and be ready to return in five to ten minutes. It is towed down beyond the Boston Light at ebb tide and the refuse material dumped at that point. In this way 800 loads per week have been disposed of, at a great saving in cost of horses and teams.

Under the statutes relative to offensive trades, complaints have been made with reference to two fertilizer manufactories, one petroleum refinery, and one fish-smoking establishment. In the case of the Common Sense Fertilizer Co., an order having been issued prohibiting the exercise of such trade, the company appealed to the superior court, and a jury impanelled for the purpose altered the order of prohibition so that the company were allowed to conduct their business under restrictions. In the case of the Bowker Fertilizer Co., at Brighton, an agreement was made by the company to conduct their business in a manner which should be unobjectionable.

The equipment of the quarantine department is in good condition and working well.

Bradford. (Pop. 2,643.) Chapter 98, Acts of 1884, is complied with. Twelve cases of scarlet fever were reported. Scarlet fever, influenza, consumption, diarrhœal diseases, typhoid fever, lung fever and rheumatism were prevalent. The work of the board of health has related only to the examination of nuisances, such as vaults, drains, those caused by the keeping of swine, and, in one instance, a large deposit of "night soil." Bradford has no system of sewerage. The town has two public sewers, which are independent of each other: both terminate in Merrimack River. The attention of the school committee has been called to the subject of the vaccination of school children, and they will attend to it when the school reopens.

Bridgewater. (Pop. 3,620.) Diphtheria and scarlatina slightly prevalent. Board employs an agent.

Brimfield. (Pop. 1,203.) Consumption, diarrhœal diseases and rheumatism were prevalent. Lung fever quite prevalent. No public water supply or system of sewerage.

Brockton. (Pop. 13,608.) Chapter 98, Acts of 1884, partially complied with. Cases reported to the board of health: scarlet fever, 10; diphtheria, 8. Scarlet fever, diphtheria, consumption, diarrhœal diseases and typhoid fever were slightly prevalent. The board of health has had a thorough inspection of all public and private buildings, with a thorough cleansing of cellars and back yards. No noxious or offensive trades have come to the notice of the board. Excavators are employed for the removal of contents of vaults and cesspools; the sewage being carted away and used on land, or buried in trenches. No pollution of water supply known to exist.

Burlington. (Pop. 711.) Chapter 98, Acts of 1884, is generally complied with. Two cases of scarlet fever reported.

Cambridge. (Pop. 52,669.) Four hundred and ninety-six cases of scarlet fever and 225 of diphtheria were reported for the year ending Dec. 31, 1884. Scarlet fever was unusually prevalent. Two hearings have been had by reason of complaints from parties living in the vicinity

of grease-rendering establishments. There are only these two in the city. The water supply is good. The mud-holes of Fresh Pond have been cut off by embankments, and the bottom of the pond cleaned. Pipes are now being laid for a supply from Stony Brook. All sewage empties into Charles River: parts of the river basin are exceedingly foul from this cause. Near Craigie Bridge, the outlet of Bridge Street sewer three or four years ago became so exceedingly offensive as to require dredging. This is now done every spring. Vaccination statutes are enforced. From house to house inspection was made during the year by physicians appointed for the purpose, and all sanitary defects found reported to this office. Houses are disinfected where scarlet fever and diphtheria have occurred. Dr. Dunbar, the milk inspector, is making a large number of examinations, and analyzing a large number of specimens. Quite a quantity of the milk is raised in the city, and is obtained from cows that are kept, as a rule, in badly ventilated, poorly constructed, overcrowded barns or stables, some of them being kept up during the whole of the year. These filthy and overcrowded stables are among the worst nuisances the board of health has to contend with.

CARLISLE. (Pop. 478.) Chapter 98, Acts of 1884, is complied with.

CARVER. (Pop. 1,039.) Chapter 98, Acts of 1884, is complied with on the part of the board of health, not otherwise.

CHELMSFORD. (Pop. 2,553.) Two sorts of offensive trades exist. The use of fish offal as a fertilizer, spread on the soil and ploughed in. Also the manufacture of artificial fertilizers.

CHILMARK. (Pop. 494.) Measles and rheumatism slightly prevalent.

CLINTON. (Pop. 8,029.) Chapter 98, Acts of 1884, is complied with. The board of health has a health officer, who investigates complaints of nuisances: he has inspected the sanitary conditions of the school buildings. The water supply is in no danger of pollution. The matter of sewerage is under consideration.

CONWAY. (Pop. 1,760.) Whooping cough has been quite prevalent, and there have been a few cases of scarlet fever.

CUMMINGTON. (Pop. 881.) Scarlet fever, measles, influenza, consumption, typhoid fever and lung fever slightly prevalent. Diarrhœal diseases were quite prevalent. Only one complaint has been made to the board of health this year. That was in regard to a pond of stagnant water. We attended to it at once, and had it thoroughly drained at a considerable expense.

DALTON. (Pop. 2,052.) There has been only one case that has come to the notice of the local board of health, and that was to order animals buried that had died and been left unburied.

DANA. (Pop. 736.) Two cases of scarlet fever reported to the local board of health.

DARTMOUTH. (Pop. 3,430.) Scarlet fever, diarrhœal diseases and whooping cough were slightly prevalent.

DEERFIELD. (Pop. 3,543.) Has been very healthy during the year.

DENNIS. (Pop. 3,288.) Chapter 98, Acts of 1884, is not complied with.

DIGHTON. (Pop. 1,791.) Influenza very prevalent; scarlet fever, measles, diarrhœal diseases and lung fever slightly prevalent. Ten cases of scarlet fever reported to the local board of health. Board of health has caused the burial of animals left unburied. No noxious trades; sewerage led into cesspools, or on ground. Board endeavors to keep sewage from wells and have cesspools cleaned to avoid smell.

DRACUT. (Pop. 1,595.) No cases of sickness have been reported to the board. Several convictions for adulterating milk. Some of the cows in town, we have reason to believe, are fed on swill gathered in Lowell and Lawrence.

DUNSTABLE. (Pop. 453.) No cases of small-pox, diphtheria or scarlet fever during the year. Chapter 98, Acts of 1884, is complied with.

EAST BRIDGEWATER. (Pop. 2,710.) Thirteen cases of scarlet fever and one of typhoid fever were reported to the local board. Scarlet fever, measles, influenza, consumption, typhoid fever, whooping cough, lung fever and rheumatism were prevalent. The selectmen are the board of health. A physician is appointed as agent.

EASTHAMPTON. (Pop. 4,206.) The public water supply is in no danger of pollution at present. The sewage empties into streams and living ponds. Our system is not perfected. We are improving it every year, by putting in drains and sewers in places where needed most.

EASTON. (Pop. 3,902.) No cases of contagious diseases reported to the selectmen. Whooping cough, measles and influenza were quite prevalent; scarlet fever, erysipelas and typhoid fever slightly so. Chapter 98, Acts of 1884, enforced.

EDGARTOWN. (Pop. 1,303.) Four cases of diphtheria reported; two died and two recovered. Chapter 98, Acts of 1884, is enforced.

ESSEX. (Pop. 1,670.) Twelve cases of diphtheria reported to local board.

FALL RIVER. (Pop. 48,961.) Cases reported to the board of health: measles, 620; typhoid fever, 117; scarlet fever, 90; diphtheria, 37. Diarrhœal diseases and measles were very prevalent. A thorough examination has been made of the entire city, and all nuisances found have been abated. One party engaged in an offensive trade was required to discontinue the same. The water supply is in no danger of pollution. The final disposition of sewage is into tide-water.

FLORIDA. (Pop. 459.) During the month of June, there were five cases of scarlet fever, none of which proved fatal. The houses where it existed were closed to other children. We stopped the school for one week, since which time we have seen nothing of it. The town is very healthy.

FRAMINGHAM. (Pop. 6,235.) Forty-three cases of scarlet fever and three of diphtheria were reported to the local board. The question at present before the board refers to the drainage of South Framingham. The water supply is chiefly from Farm Pond, but not in the neighborhood of any sources of pollution. The works are quite new and just beginning to be used. We are having an outbreak of malarial fever, chiefly in the neighborhood of the work now going on in Farm Pond and along the old trench leading from Farm Pond to Cochituate Lake, at South Framingham. It is certainly a very interesting fact, and will be investigated.

FREETOWN. (Pop. 1,329.) Each house takes care of its own sewage; some in vaults, some drain into river. Chapter 98, Acts of 1884, not complied with.

GARDNER. (Pop. 4,988.) There are no offensive trades here. Sewage disposal: into cesspools and brooks.

GEORGETOWN. (Pop. 2,231.) Only one offensive trade (butcher) has come under our care. A request secured its abatement.

GLOUCESTER. (Pop. 19,329.) Forty-eight cases of scarlet fever and 36 of diphtheria were reported to the board. Typhoid fever and measles were very prevalent. The board has not been called upon to pass upon noxious or offensive trades. Its main work has been in the removal of nuisances caused by stagnant water, privy vaults and cesspools. Complaints have been made of the water supply, and samples will be sent to your board for analysis. The sewage is disposed of by cesspool treatment, with a small portion discharged into the harbor. No special measures have been taken for the control of infectious diseases beyond prompt and efficient action to prevent their spread through the public schools. Scarlet fever has prevailed to a greater or less extent; but the cases have been mostly of a mild type, and there have been few deaths.

GREENFIELD. (Pop. 3,903.) One hundred and fifty cases of scarlet fever were reported to the local board. Scarlet fever, measles and influenza were very prevalent. Consumption, diarrhœal diseases and lung diseases were slightly prevalent. There is no danger of the water supply being polluted. The statutes in regard to the registration of contagious diseases are complied with.

GROVELAND. (Pop. 2,227.) Chapter 98, Acts of 1884, is enforced.

HANSON. (Pop. 1,309.) Two cases of scarlet fever reported. The selectmen act as board of health, and have very little to do. No noxious trades. No water supply. No system of drainage.

HARWICH. (Pop. 3,265.) Whooping cough, rheumatism and diarrhœal diseases prevalent.

HATFIELD. (Pop. 1,495.) Chapter 98, Acts of 1884, is enforced.

HOLLAND. (Pop. 302.) Two cases scarlet fever reported. Our town is very small, and there are no offensive trades of any kind. No measures have been adopted for the prevention of contagious diseases. Chapter 98, Acts of 1884, is complied with.

HOLLISTON. (Pop. 3,098.) Eight cases of scarlet fever and six of diphtheria were reported. No diseases unusually prevalent. The board adopted rules and regulations, and had them printed and circulated in the local papers every week, from May 1 to Nov. 1. The people seem willing to comply with the rules. Great care is used to prevent the spread of contagious diseases in the schools. Chapter 98, Acts of 1884, is complied with. Certificates of health are required of scholars after recovering from contagious diseases.

HUBBARDSTON. (Pop. 1,386.) Our town is very healthy, and we have no occasion to adopt any measures for the control of contagious diseases.

HUNTINGTON. (Pop. 1,236.) Chapter 98, Acts of 1884, enforced.

HYDE PARK. (Pop. 7,088.) Seventy-nine cases of scarlet fever, 2 of which died; 24 cases of diphtheria, 9 of which died; 11 cases of typhoid fever, 2 of which died. Scarlet fever and diphtheria unusually prevalent. There are no offensive or noxious trades requiring attention. There is at present no system of sewerage. Some of the sewage goes into the Neponset River, from the factories, etc. Vaults and cesspools are carefully cleaned, and their contents deposited upon farms. Great pains have been taken by our board of health in overseeing this work. We shall soon require some system of sewerage, as the use of water increases.

IPSWICH. (Pop. 3,699.) No noxious trades. No water supply. The water of a brook near centre of town has long been used for domestic purposes, but is now polluted by drainage of gas-works so as to render it unfit for use. Other drainage from houses also now increases its pollution. Chapter 98, Acts of 1884, is complied with.

KINGSTON. (Pop. 1,524.) Two cases of scarlet fever were reported to the local board. Scarlet fever and measles were prevalent. Chapter 98, Acts of 1884, complied with.

LAKEVILLE. (Pop. 1,008.) Chapter 98, Acts of 1884, complied with. The sewage is used for a fertilizer.

LANCASTER. (Pop. 2,008.) During March, April, May and June, influenza, whooping cough and mumps prevailed quite extensively. Water from Sterling is now being introduced.

The sewage is mostly disposed of by surface drainage and used by the farmers to put on their land.

In 1882, all school children were vaccinated by vote of the town.

This year, the board of health have called the attention of the school committee to sect. 9, chap. 47, Public Statutes (*Vaccination of School-children*).

Chapter 98, Acts of 1884, complied with.

During the summer of 1881, various complaints were heard relative to the sanitary condition of several somewhat public places, slaughter and soap houses, one or more public boarding-houses, etc., the atmosphere furnishing sufficient evidence of contamination. As the selectmen were the recognized board, no action was taken for the relief of the complainants.

In March, 1882, the necessity of a board of health was brought before the town, and the town elected three physicians to serve as a board of health, — two in active practice, with one retired from practice for some years.

Immediately upon organization, the board gave public notice that they were prepared to thoroughly examine all complaints of nuisances, sources of filth, or any violation of sanitary conditions, and to correct the same if within their power. Result: not a single complaint was brought to their notice during the following year.

Under such circumstances, the selectmen resumed power for the year 1883.

During the summer of 1883, numerous cases of scarlet fever occurred, some 30 in number, with one death, without *notice* from either householder or physician; the latter a resident of an adjoining town, destitute of a board of health, but where one is greatly needed. Fortunately, the epidemic was of very mild character, confined to one locality; and when the facts were accidentally discovered, red flags, with thorough fumigation, were applied by direction of the old board of health. No further cases. With such neglect, a board of health for the town again became a necessity, and the town re-elected the old board for 1884.

After organization, it was resolved to take a new departure; viz., that the two active physicians should visit in rotation every dwelling, both public and private, so far as their engagements would allow, thoroughly examine the sanitary conditions of all parts and report to the board, the third member to act as a reserve power, to be called upon when energetic action should be required. This plan was fully carried out, some 150 dwellings visited and carefully examined during the summer, and I must say that the results were truly astounding, for while they found, among the wealthy and more enlightened, every care and convenience for the health of their families, yet there existed numerous instances where, either from ignorance, thoughtlessness or indifference, everything that common sense or the slightest thought would demand for their own health and comfort of their families was wholly neglected. Sink drains of cobble stones, — old, broken down, in some cases blocked up and impervious, — perhaps terminating within 10 or 12 feet of the family well, of a depth of 16 or 18 feet. The surrounding surface saturated with filth deposit to a depth unknown, but which from necessity must penetrate to the well after heavy rains.

Privies, with large brick, cement-lined vaults beneath, a general recep-

tacle for every kind of filth to the depth of 2 or 3 feet, the contents liable to be frozen in winter, followed by fracture of cement lining, and, when near a water supply, a direct source of pollution. In some cases the water is so offensive as to be wholly beyond use for any purpose.

In most cases, the requirements of the board were cheerfully complied with, and drain tiles became an institution during the past summer; and we hope to complete the examination of every dwelling not hitherto visited, the coming summer, and apply such reform as may be required.

As careful observers, we have arrived at certain conclusions, that we think will apply to most country towns throughout the State, viz.:

1st. That a law should be passed requiring the annual election of a board of health, of three or five proper persons, in every town throughout the State, to render an annual report to the town of their proceedings, with such suggestions and recommendations as they may deem expedient. (Perhaps a three years' election, same as school committee, would be the better plan.)

2d. That the board, wherever practicable, should consist of at least *two*, and in larger places of three, physicians, as the only class in whom the community will have full confidence on this subject.

I might with propriety close here, but our experience has led us to believe, that in towns without a full water supply, everything in the form of cesspools, vaults, or depressions beneath privies, should be banished; and in place thereof the surface should be level, of brick or stone laid in cement, with four round iron rods to carry two drawers of soapstone, wood, or same material as drain tile, furnished with handles that they may easily be withdrawn. Such appliances, with a supply of dry absorbent material near at hand, can be cleansed in ten minutes and made as pure as the house itself.

True, it would require a little time and care once a week, but the time has arrived when the people should be taught that one of their first duties is to protect themselves and families by a proper observance of sanitary laws.

LEICESTER. (Pop. 2,779.) The second section, chapter 98, Acts of 1884, is wholly disregarded by some physicians.

LENOX. (Pop. 1,845.) Three cases of scarlet fever reported. No offensive trades. Work of board principally in regard to disposition of house offal. Sewage disposed of after the Waring system.

LEXINGTON. (Pop. 2,460.) Members of the board visit houses and inspect premises whenever cases of infectious diseases are reported. Water supply in no danger of pollution. Cesspools used for sewage disposal. Chapter 98, Acts of 1884, enforced.

LINCOLN. (Pop. 907.) Chapter 98, Acts of 1884, is complied with.

LITTLETON. (Pop. 994.) Ten cases of scarlet fever and two of diphtheria were reported to the board. Typhoid fever and diarrhœal diseases slightly prevalent.

Lowell. (Pop. 59,475.) All sewage empties into the Merrimack River. Ninety-one cases of scarlet fever and 44 of diphtheria.

Ludlow. (Pop. 1,526.) Chapter 98, Acts of 1884, complied with.

Lunenburg. (Pop. 1,101.) The town is very healthy. No offensive or noxious trades. No cases of contagious disease reported to the board.

Malden. (Pop. 12,017.) One hundred and fourteen cases of scarlet fever and 14 of diphtheria were reported for the year ending Dec. 31, 1884.

Spot Pond is source of water supply, and the pond is subjected to such pollution as all ponds are liable to, but the water board is very careful to prevent such by all means in their power. There is no system of sewerage. The city has appointed an inspector of milk, who is actively attending to his duties.

Marshfield. (Pop. 1,781.) Measles quite prevalent in the winter and spring. No offensive trades. The deposit of kelp or rockweed near the shore villages has been forbidden for periods of more than 36 hours.

We have published extracts from statutes and notified physicians and school committee in regard to children resuming school after sickness. We experience considerable trouble from the carcasses of whales drifting on our shores. We have had three calls to remove or bury such carcasses.

Mashpee. (Pop. 346.) No precaution taken as to infectious diseases in schools.

Mendon. (Pop. 1,094.) During 1884 there was very little sickness in the town. There is need of a better system of sewage disposal in the principal village.

Merrimac. (Pop. 2,237.) Thirty-five cases of scarlet fever and three of diphtheria reported to the board. Nearly 100 cases of scarlet fever since a year ago last June.

Methuen. (Pop. 4,392.) Seven cases of diphtheria and six of scarlet fever reported to the board. Influenza and diarrhœal diseases very prevalent, and typhoid fever, diphtheria, measles, whooping cough and scarlet fever slightly so.

Middlefield. (Pop. 648.) Chapter 98, Acts of 1884, is complied with.

Milton. (Pop. 3,206.) The greatest nuisance in the town is the sale and delivery of city swill. This swill undoubtedly is at the bottom of most of the "piggery nuisances" in the town. Unless fed immediately, it very quickly becomes a foul, decomposing mass. As long as the city allows this to be sold, and carted through Dorchester, the local board of health is more or less powerless to act in the matter.

Monroe. (Pop. 166.) Acts of 1884, chapter 98, is complied with.

MONTEREY. (Pop. 635.) There are no noxious or offensive trades in Monterey. Chapter 98, Acts of 1884, complied with.

NAHANT. (Pop. 808.) Seventeen cases of scarlet fever reported to the local board. Measles have been very prevalent. The sewerage system is perfect: the sewers empty into the Atlantic. Acts of 1884, chapter 98, complied with.

NANTUCKET. (Pop. 3,727.) Consumption and diarrhœal diseases very prevalent; erysipelas and typhoid fever slightly so.

NEEDHAM. (Pop. 4,548.) Twenty-five cases of scarlet fever reported. Scarlet fever very prevalent.

NEW BEDFORD. (Pop. 26,845.) Thirty-seven cases of diphtheria and eight of scarlet fever. Measles and consumption very prevalent. Diarrhœal diseases, whooping cough and typhoid fever slightly prevalent. We have excluded slaughtering from the city limits. Have had much trouble with rendering establishments, and shall exclude them from the city if the nuisance continues. The city is on a hill: toward the east the sewers run into the river; toward the west, into a brook, which has been taken into a large brick sewer. Cases of infectious diseases are at once reported to the board, and investigated: a printed circular is left at the house, and cases isolated as much as possible. The children are kept out of school.

NEW BRAINTREE. (Pop. 610.) Acts of 1884, chapter 98, complied with.

NEW SALEM. (Pop. 869.) The people of the town were quite free from contagious diseases last year.

NEWTON. (Pop. 16,995.) Reports 128 cases of scarlet fever and 33 of diphtheria for the year ending Dec. 31, 1884. The water supply appears to be in no danger of pollution. Acts of 1884, chapter 98, enforced.

NORTHAMPTON. (Pop. 12,172.) Intermittent and remittent fever have been extremely prevalent; also minor affections, due to malarial poison. It has been remarked that during the prevalence of malarial affection we seem less likely to have an nnusual prevalence of other infectious diseases.

The abatement of thirty-seven minor nuisances and the construction of sewers by the influence of the board has been the work this year. No noxious or offensive trades have been brought to the notice of the board.

The sewage goes into Mill River, a small stream which runs through meadows and then empties into the Connecticut River. The meadows are inundated almost every year, so that no dwelling-houses can ever be built within more than a mile from the mouth of Mill River. The combined system is most generally used.

The city has just received a gift of $100,000 for a hospital, and the building has been erected; into this hospital most cases of diseases among the poorer classes will go. Seven cases of diphtheria and five of scarlet fever reported to board.

North Andover. (Pop. 3,217.) We have no public water supply, and the wells in this village are not deep and the water generally not very good. The principal streets of the village have very imperfect sewers. The provisions of Chapter 98, Acts of 1884, not strictly complied with.

Norwood. (Pop. 2,345.) Very healthy. Four cases of diphtheria and three of scarlet fever reported to the board.

Paxton. (Pop. 592.) One case of diphtheria reported. Whooping cough prevalent.

Pittsfield. (Pop. 13,364.) Reports 38 cases of diphtheria and nine of scarlet fever. The sewage runs into the river. We have not as many sewers as we need, but are building nearly every year. Acts of 1884 chapter 98, complied with.

Diphtheria, diarrhœal diseases, consumption and pnuemonia prevalent.

Plympton. (Pop. 694.) Acts of 1884, chapter 98, complied with.

Provincetown. (Pop. 4,357.) The town was divided into three districts, each represented by a member of the board. Personal inspections were made and complaints attended to. We have considerable diarrhœa and some dysentery, but few cases of cholera infantum. Cholera morbus is very prevalent this season, and some are very severe cases. Influenza began here last December and lasted until May. Measles has prevailed since last fall; is still prevailing. The sewage, offal and garbage is emptied into the sea.

Randolph. (Pop. 4,027.) Eighteen cases of diphtheria and two of scarlet fever reported. Inspections made and nuisances abated. Acts of 1884, chapter 98, enforced.

Richmond. (Pop. 1,124.) Acts of 1884, chapter 98, enforced.

Rochester. (Pop. 1,043.) One case of diphtheria and 11 of scarlet fever reported to board.

Rockland. (Pop. 4,553.) Scarlet fever, measles and consumption very prevalent. One soap and tallow factory was complained of, certain modifications were made in the process, which is not yet conducted in a satisfactory manner. There is no system of sewerage.

Sandisfield. (Pop. 1,107.) Acts of 1884, chapter 98, complied with.

Savoy. Two cases of diphtheria and one of scarlet fever reported to the board.

Scituate. (Pop. 2,466.) Acts of 1884, chapter 98, not complied with

Sharon. (Pop. 1,492.) Four cases of scarlet fever reported to board. Public water supply being introduced. Acts of 1884, chapter 98, complied with.

Shutesbury. (Pop. 529.) Three cases of scarlet fever reported to board. Acts of 1884, chapter 98, complied with.

Southbridge. (Pop. 6,464.) Chapter 98, Acts of 1884, was not complied with in 1884.

The sewage in the most thickly settled portions of the town has been disposed of in a small brook that runs through the village. Said brook is dry some portions of the year and has been a great nuisance. Sewerage is needed.

Spencer. (Pop. 7,466.) The sewage empties into a brook about two miles from the village, the brook empties into Seven Mile River. There have been some complaints about it, and probably the sewer will have to be extended so as to empty nearer the river. As it empties now it is above a mill dam. There are three woollen factories on the brook which also pollute the water.

Sterling. (Pop. 1,414.) Acts of 1884, chapter 98, complied with.

Stoneham. (Pop. 4,890.) Diphtheria has been very prevalent. Seventy-eight cases of diphtheria and 32 scarlet fever reported to board. Acts of 1884, chapter 98, enforced.

Stow. (Pop. 1,045.) Erysipelas, typhoid fever, lung fever and rheumatism quite prevalent.

Sudbury. (Pop. 1,178.) Acts of 1884, chapter 98, enforced.

Sunderland. (Pop. 755.) Acts of 1884, chapter 98, enforced.

Sutton. (Pop. 3,105.) Acts of 1884, chapter 98, not enforced.

Templeton. (Pop. 2,789.) Acts of 1884, chapter 98, enforced.

Topsfield. (Pop. 1,165.) Six cases of scarlet fever and one of diphtheria reported to the local board. No deaths occurred from these cases. Chapter 98, Acts 1884, is complied with.

Uxbridge. (Pop. 3,111.) Acts of 1884, chapter 98, enforced.

Upton. (Pop. 2,023.) Two streets in the town are provided with aqueduct water coming through pipe one-half mile from tank. The locality of reservoir such as no pollution can enter. So far as relates to our own products, — milk, butter, etc., — they are pure and good. For artificial feeding of infants, when I can control circumstances, I find best results from Ayrshire milk of good average quality, from stall-fed cows, kept on good sweet hay, bran mash; and in summer, allow fresh selected grass cut and given with other food as above. This refers to infants under six or eight months, when having summer complaint.

I have been very much interested in the subject of infant feeding. Believing that much of the mortality in early infant life was due to injudicious feeding from ignorance and carelessness, I have endeavored to control this part of the treatment. By so doing, I think good results have been obtained.

WALTHAM. (Pop. 11,712.) Number of cases reported to local board: scarlet fever, 60; diphtheria, 24; typhoid fever, 20; cerebro-spinal meningitis, 1.

CITY OF WALTHAM,
OFFICE OF THE BOARD OF HEALTH.

1. *Work of the Board.* — At the beginning of this season's work, the first of March, the management of the swine question was met, and the board assumed authority, under the statutes, to enact a regulation requiring all keepers of swine to have a license therefor, given by the board of health, stating the number to be kept. A condition expressed in the license is that the swine shall be kept at all times clean and unoffensive. The board has had no occasion to revoke a license, but three parties have been fined by the court for keeping swine without a license.

A sanitary survey and inspection of dwellings and the surroundings thereof in the central portion of our city was made. The information obtained furnishes data as to number and character of cesspools and privies; number and character of buildings; number and nationality of families; their occupations; number of adults and of children; disposition of sewage and swill; water supply, etc. All cellars were examined; also all privies and waste-pipes, where they were in view. Owners have been required to trap all sinks or other fixtures requiring it, and to remedy defects in construction whereby polluted liquids or gases escaped into or beneath dwellings.

Regulations have been made and enforced governing house drainage. We have been obliged to prosecute one party for violation of regulations, but the work has generally been satisfactory.

We have dealt with but one case of offensive trades, which case was that of a meat extract company. A petition was presented to the board asking for the discontinuance of said establishment. An investigation disclosed carelessness in disposing of the waste products, — animal matter, — but nothing necessarily offensive about the business.

2. *Public Water Supply* — Our supply is public, taken from a filtering gallery, so called, thought to be fed by springs, and excavated on the shore of Charles River, above the populated part of the city. Its purity is threatened by the proximity of the U. S. Quarantine Station, whereon are kept, at times, large numbers of cattle. Can be averted by removal of station, which is contemplated and probable.

3. *Drainage and Sewerage.* — We have no system of drainage for sewage. We await only a place of disposal before sewering a large portion of the densely populated part of our city. We have a large number of drains for surface water, only a few of which have been laid with reference to drainage districts. We have a sewage commission formulating systems of these latter drains.

4. *Infectious Diseases.* — Special examinations have been made of dwellings wherein occur diphtheria and typhoid fever, and copies of the State Board's circulars concerning the prevention of the spread of diphtheria and scarlet fever are distributed in each instance reported.

We have reason to believe that the statutes relative to the requirement of vaccination of all public school scholars have not hitherto been strictly enforced. We have this year requested the school committee to take pains to ensure the enforcement of the laws.

5. The provisions of chapter 98, Acts of 1884, have been complied with as far as they relate to physicians.

WAREHAM. (Pop. 2,896.) A slaughter-house was complained of, was attended to, and nuisance abated. Chapter 98, Acts of 1884, is enforced.

WARREN. (Pop. 3,889.) One public sewer in progress. Sewage ultimately runs to Quaboag River.

WATERTOWN. (Pop. 5,426.) Three cases of scarlet fever reported to board.

Work of the Board. — Since organization, and adoption of rules by the board of health, a medical agent has been appointed to examine all houses, and make report upon the sanitary condition of the same. The work has been faithfully done, and the agent is still looking after all cases. There are one or more piggeries that we may be forced to proceed against. We have also protested against the erection of soap works in Newton, near to our town line, and draining into Charles River above the bridge on Galen Street in Watertown.

WEST NEWBURY. (Pop. 1,989.) Measles were quite prevalent for a time, and the schools were closed. Chapter 98, Acts 1884, is not enforced.

WESTPORT. (Pop. 2,894.) Chapter 98, Acts of 1884, partly enforced.

WEST SPRINGFIELD. (Pop. 4,149.) The sewage drains into the Connecticut River. Cases reported to the board: scarlet fever, 15; diphtheria, 11. Acts of 1884, chapter 98, complied with.

WESTBOROUGH. (Pop. 5,214.) Blank returns have been prepared for physicians, for the purpose of reporting contagious diseases, as provided by chapter 98, Acts of 1884.

WEST BOYLSTON. (Pop. 2,994.) Health regulations, printed in French and English, have been issued to every household, and people have readily complied with them.

WEYMOUTH. (Pop. 10,570.) Fifteen cases of scarlet fever and one of diphtheria reported to board. Chapter 98, Acts of 1884, is not wholly enforced. No public water supply nor sewerage system.

WILMINGTON. (Pop. 933.) The statutes relative to the reporting of contagious diseases are partially complied with.

WILLIAMSTOWN. (3,394.) All sewage goes into Hoosac and Green rivers. Chapter 98, Acts of 1884, complied with. There have been many cases of diphtheria in Blackinton, part of which is in Williamstown. Disinfection and isolation were employed.

WINCHESTER. (Pop. 3,802.) Forty-nine cases of scarlet fever were reported (three fatal). Sewage purification works of Mystic Valley visited twenty times by the board, and two remonstrances made to Boston water board against burning dry sludge (both effectual). Sewage disposed of by cesspool and soakage. Four complaints of unsanitary state of buildings

used by many tenants. Landlords reasonable. Twelve or more complaints settled by clerk. Piggery (having 600 swine or more) on watershed of water supply, and draining into or towards it, brought to notice of the State Board. Infectious diseases reported by physicians. Neighborhood isolation, less visiting in families, and more efforts to separate the sick and the well.

Woburn. (Pop. 10,931.) Reports 89 cases of scarlet fever and 14 of diphtheria.

Worcester. (Pop. 58,291.) Three hundred and thirty-one cases of diphtheria and 66 of scarlet fever reported to local board of health. Diphtheria and scarlet fever prevailed during the year, diarrhœal diseases in the summer months, lung fever from January to April. No offensive trade reported within the year. Chapter 98, Acts of 1884, is enforced. Inspections made in cases of complaint. Cases of infectious disease receive immediate attention. The school authorities are notified of the location of every case, and truant officers visit them, and prevent the attendance of infected children at school. All sewage goes into the Blackstone River.

Wrentham. (Pop. 2,481.) Scarlet fever and measles have been prevalent in a mild form during the year.

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